Network for Greening the Financial System

Technical document

Guide for supervisors: Integrating climate and nature-related risks into prudential supervision

September 2026

NGFS

Central Banks and Supervisors
Network for Greening the Financial System

Table of Contents

Foreword 4

Executive summary 5

Introduction 7

1. Climate and nature-related risks as a source of financial risks 9
   - 1.1 Definition of climate and nature-related risks 9
   - 1.2 Transmission to the financial system 11
   - 1.3 Climate and nature nexus: financial implications 14

2. Awareness raising, organisational arrangements and capacity building for supervisors 15
   - 2.1 Supervisors' mandate 16
   - 2.2 High-level governance and strategic roadmaps 17
   - 2.3 Organisational arrangements 19
   - 2.4 Raising awareness of climate and nature-related risks 23

3. Assessing and quantifying climate and nature-related risks 25
   - 3.1 Risk exposures, quality of control procedures and residual risks 25
   - 3.2 Stocktake of data needs 26
   - 3.3 Qualitative assessment of climate and nature-related risks 30
   - 3.4 Quantitative assessment of climate and nature-related risks 32
     - 3.4.1 Physical risks resulting from climate change 32
     - 3.4.2 Transition risks resulting from climate change 36
     - 3.4.3 Nature-related risks 40
   - 3.5 Scenario analysis and stress tests 43
     - 3.5.1 Scenario analysis and stress tests for climate-related risks 43
     - 3.5.2 Scenario analyses and stress test exercises for nature-related risks 51

4. Supervisory guidance for financial institutions 54

4.1 International frameworks for financial institutions 54

4.2 Main areas covered in supervisory guidance 55

4.3 Developing supervisory guidance 57

4.4 Implementing and monitoring supervisory guidance 58

4.5 Supervisory guidance regarding transition planning and transition plans 61

4.6 Supervisory guidance regarding nature-related risks 63

5. Prudential framework and tools 64

5.1 Micro-prudential framework 64

5.1.1 Pillar 1 64

5.1.2 Pillar 2 65

5.1.3 Pillar 3 73

5.1.4 Integration of nature-related risks in the micro-prudential framework 74

5.2 Micro-prudential tools 74

5.2.1 Thematic reviews conducted by supervisors 74

5.2.2 Transition plans 75

5.3 Macro-prudential framework and tools 76

5.3.1 Risk identification and monitoring 77

5.3.2 Vulnerability assessment through climate scenario analysis 77

5.3.3 Policy and regulatory responses to enhance resilience 78

5.4 Other supporting tools: taxonomies 80

6. Looking forward 84

7. Annexes 85

Annex A: List of useful material to be collected from institutions by supervisors 85

Annex B: Overview of the sources of nature-related risks and their transmission to the economy 88

Acknowledgements 91

References 92

Foreword

Olaf Sleijpen
De Nederlandsche Bank
Chair of the NGFS

Alberto Casillas Cuevas
Banco de España
Co-Chair of the Workstream Supervision

Donald Chen
Hong Kong Monetary Authority
Co-Chair of the Workstream Supervision

Climate and nature are a source of financial risks, and supervisors should therefore ensure that the financial system is resilient to these risks. This message, featured in the NGFS 2020 Guide for Supervisors, remains as relevant today as it was then. Indeed, since the publication of the Guide, climate and nature-related financial risks have become more visible and increasingly relevant to financial stability and the safety and soundness of financial institutions. At the same time, supervisory practices have continued to evolve across jurisdictions.

This updated Guide reflects these developments by incorporating emerging areas of supervisory practice, including nature-related financial risks, transition planning, adaptation measures and other evolving topics. In doing so, it recognises both the progress already achieved and the need for supervisors to continue adapting their approaches as understanding, methodologies and supervisory expectations mature.

A central objective of this update is to make the Guide as practical and accessible as possible for supervisors across all regions and institutional contexts. Drawing on a wide range of supervisory experiences and practical case studies, it provides flexible pathways that supervisors can adapt to their own circumstances, helping to translate evolving concepts into actionable supervisory practices.

As with the first edition of the Guide, we hope that the recommendations contained in the 2026 edition will become so widely embedded in day-to-day supervisory practice that a dedicated guide of this nature will no longer be needed.

We express our sincere thanks to all NGFS workstream members who have contributed to drafting and reviewing this update, as well as the stakeholders who have shared their expertise and insights. A special thank you goes to the members who have coordinated the update of the Guide for their leadership and dedication, and to the NGFS Secretariat for its continued support in driving our work forward.

Executive summary

Recognising that climate-related risks can translate into financial risks, the NGFS issued a call to action in 2019, urging central banks and supervisors to assess these risks and better understand their implications for the financial system. This foundational principle guided the initial publication of the Guide for Supervisors: Integrating Climate-related and Environmental Risks into Prudential Supervision in 2020 (NGFS, 2020), which provided a framework for integrating climate and nature considerations into supervisory activities.

Since the publication of the first Guide, climate and nature-related financial risks have become increasingly evident, while supervisory practices have continued to evolve. This revised Guide incorporates the latest developments in supervisory practices, including those concerning nature-related financial risks, transition planning, climate scenarios and stress testing, climate-related litigation risks, and climate-related disclosure frameworks, and provides updates to the framework in the first Guide for the integration of climate and nature considerations. Compared with the 2020 Guide, greater attention is also given to the role of adaptation and forward-looking resilience measures in shaping the materiality of physical risks and informing the supervisory assessment of residual risks. It adopts a progressive and proportionate approach, recognising the diversity of supervisory mandates, institutional arrangements and resource constraints across jurisdictions. Drawing on a survey of 67 supervisory authorities and numerous case studies from NGFS members, it offers practical examples and flexible approaches that supervisors can adapt to their own contexts. In so doing, this update of the Guide aims to raise awareness on the importance and feasibility of including climate and nature-related risks within supervisory frameworks and practices, and help members build capacity on the topic.

Understanding climate and nature-related financial risks

The Guide begins by defining climate and nature-related risks and explaining how physical and transition risks can be transmitted to the economy, financial institutions and the broader financial system. Understanding these transmission channels is a prerequisite for identifying material vulnerabilities, prioritising supervisory actions and developing a common supervisory understanding of these risks.

Recommendation 1 – Determine how climate and nature-related risks transmit to the economies and financial sectors in their jurisdictions and identify how these risks are likely to be material for supervised entities.

Embedding climate and nature-related risks within supervisory organisations

Building on this foundation, the Guide examines how supervisors may integrate climate and nature-related considerations into their organisation and activities. It discusses the role of supervisory mandates, governance arrangements, strategic roadmaps, internal coordination mechanisms, resource allocation, capacity building and engagement with external stakeholders. Recognising the diversity of institutional contexts, the Guide highlights a range of approaches observed across jurisdictions.

Recommendation 2 – Develop a clear strategy, establish appropriate organisational arrangements and allocate adequate resources to address climate and nature-related risks. Supervisors must consider the relevance of these risks within their mandates and support awareness-raising and capacity-building efforts across their organisations.

Assessing and quantifying climate and nature-related risks

The Guide then focuses on the identification, assessment and monitoring of climate and nature-related financial risks. It presents supervisory practices for collecting relevant data, assessing exposures, developing risk indicators, and conducting qualitative and quantitative analyses. It also discusses the growing use of scenario analysis and stress testing as tools to better understand the potential financial impacts of climate and nature-related risks under different future pathways.

Recommendation 3 – Identify supervised entities' exposures to climate and nature-related risks, using qualitative and/or quantitative tools, and assess the potential losses arising from the materialisation of these risks.

Developing and implementing supervisory expectations

A key component of effective supervision is the establishment and articulation of clear supervisory expectations. The Guide reviews international guidance and leading practices related to governance, strategy, risk management, scenario analysis, stress testing and disclosures. It also explores how supervisory expectations can be developed, communicated, monitored and progressively expanded to address emerging areas such as nature-related risks.

Recommendation 4 – Establish, implement and monitor supervisory expectations, aligned with relevant international guidelines, to provide financial institutions with clarity on prudent approaches to managing climate and nature-related risks.

Integrating climate and nature-related risks into prudential frameworks

Finally, the Guide examines how climate and nature-related risks may be reflected within prudential frameworks and supervisory tools. It discusses considerations across the three pillars of prudential regulation and presents a range of micro-prudential and macro-prudential tools that can be used by supervisors to assess and address these risks. These include thematic reviews, transition plans, stress testing exercises and the monitoring of system-wide vulnerabilities. While many current practices focus on climate-related risks, the Guide highlights how these approaches may increasingly be adapted to address nature-related risks.

Recommendation 5 – Ensure adequate management of climate and nature-related risks by financial institutions and take mitigating supervisory action where appropriate, including by considering how such risks may be addressed within the prudential framework.

Taken together, these five recommendations provide a practical roadmap for supervisors seeking to strengthen the resilience of supervised entities to climate and nature-related risks. As supervisory approaches continue to evolve, the Guide aims to support convergence in supervisory practices while preserving the flexibility required to accommodate different mandates, proportionality, legal frameworks and national circumstances.

Looking ahead, the NGFS has identified several areas for further work, which may be pursued by the NGFS itself or taken forward by other relevant organisations. In the area of risk assessment, further work could focus on the development of integrated climate-nature risk assessments, the better incorporation of adaptation and mitigation measures into risk analysis, and the continued advancement of climate and nature scenario analysis by both supervisors and financial institutions. In relation to prudential frameworks, further exploration is warranted on how micro-prudential and macro-prudential tools may address climate and nature-related vulnerabilities and support evidence-based supervisory responses to emerging risks. Finally, in capacity building, supporting the exchange of supervisory good practices, improving data and methodologies, and strengthening knowledge-sharing across jurisdictions remain critical. These efforts can build on the practical experience of NGFS members and continue to be informed by close cooperation with key stakeholders, including international standard-setting bodies. Through this publication and future work, the NGFS aims to support the development of proportionate, risk-based supervisory approaches that contribute to financial stability and an orderly transition to a resilient and sustainable economy.

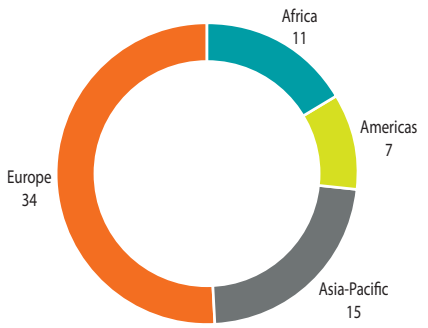
Introduction

Since the publication of the first Guide in 2020, climate and nature-related risks have become increasingly evident, underscoring the need for continued supervisory action. Prior to the release of this Guide, the year 2025 was regarded as one of the warmest years on record, with temperatures exceeding 1.5 °C above the preindustrial average (WMO, 2026). The NGFS short-term scenarios further indicate that regional extreme weather events could lead to significant gross domestic product (GDP) losses over a three- to five-year horizon, with spillover effects on the global economy, and consequently on the financial system (NGFS, 2025a). Meanwhile, supervisory practices have continued to evolve in line with a deeper understanding of climate and nature-related risks. Drawing on the work of the NGFS between 2020 and 2026, this Guide incorporates updated insights on key emerging topics, such as nature-related risks, transition plans, scenarios and stress testing, adaptation measures, climate-related litigation risk as well as considerations on climate-related disclosures aligned with global standards and recommendations, such as those issued by the International Sustainability Standards Board (ISSB) or the Task Force on Climate-related Financial Disclosures (TCFD).[1] The scope of this Guide is specifically aimed at the prudential supervision of banks and insurance companies. Nevertheless, it may provide useful guidance for the prudential supervision of other financial institutions as well.

To enhance its practical relevance, the Guide was developed based on a range of existing supervisory approaches, informed by a survey of NGFS supervisors and a series of case studies. While not exhaustive, the case studies illustrate practices observed across jurisdictions. The stocktaking survey, conducted in early 2026, gathered 67 responses, representing 70% of NGFS country members.[2] Taking into account the diversity of the NGFS membership, supervisors may interpret and draw upon this Guide depending on their mandates, capacities and supervisory contexts.

The survey highlighted the importance of the 2020 edition of the Guide in supporting the development of supervisory practices for assessing climate-related risks. More than 70% of respondents reported that they had used the 2020 Guide to inform and support their actions. The Guide sets out five high-level recommendations, building on and adapting those of the 2020 Guide, to support the progressive integration of climate and nature-related risks into supervisory frameworks and the strengthening of supervisory practices.

Figure 1 **Responses in absolute terms to the NGFS survey on supervisory practices[1]**



1 Responses were mainly received from Europe (51%), followed by Asia (22%), Africa (16%), and the Americas (11%). This distribution broadly reflects the composition of the NGFS membership. The composition of the NGFS membership is as follows: 42% in Europe, 23% in Asia-Pacific, 20% in Africa, and 15% in the Americas.

The core chapter structure of the previous edition has been retained. Chapter 1 defines climate and nature-related risks, highlighting how physical and transition risks are transmitted to the financial system. Chapter 2 outlines how climate and nature-related risks can be embedded into supervisors' organisation and activity, drawing on mandates, evolving governance structures, strategic roadmaps, and engagement actions. Chapter 3 details risk assessment processes for climate and nature-related financial supervision, followed by chapter 4, which outlines supervisory guidance on governance, risk management, and disclosures for climate and nature-related risks. Chapter 5 outlines how climate and nature-related risks can be embedded within prudential frameworks, as well as the range of micro and macro-prudential tools that supervisors may use to assess these risks. Finally, chapter 6 outlines possible directions for further supervisory exploration.

1 The formation of the ISSB was announced by the Trustees of the IFRS Foundation in November 2021 at COP26 in Glasgow, while the TCFD was established by the Financial Stability Board (FSB) in December 2015 at the request of the G20.

2 The NGFS is composed of 95 member countries as of June 2026.

The practices presented in this Guide are not intended to be implemented simultaneously or with the same degree of sophistication in all jurisdictions. Supervisors may apply them proportionately, taking into account the materiality of climate and nature-related risks, the characteristics of the financial system, their mandate and legal framework, and the availability of data, expertise and resources. Proportionality should remain risk-based: limited institutional capacity or the smaller size of a supervised institution does not necessarily imply that its climate and nature-related financial risks are immaterial.

Supervisors may adopt a progressive pathway that begins with relatively accessible actions and develops toward more data- and capacity-intensive practices. The appropriate starting point and sequence should be determined by each supervisory authority's mandate, capacity and resources, and the materiality of climate and nature-related risks in the jurisdiction. Supervisors may also pursue activities in parallel, or move directly to more advanced practices where risks are material and the necessary capabilities are available. Conversely, data or capacity limitations should not prevent initial action: available information, proxies and qualitative tools can provide a basis for identifying vulnerabilities while data, methodologies and capabilities are progressively strengthened.

1. Climate and nature-related risks as a source of financial risks

This chapter sets out the definitions of climate and nature-related risks, consistent with previous NGFS publications, which are used throughout this Guide. This initial step of defining these risks is key for supervisors, as it supports the development of a harmonized supervisory approach across financial institutions.[3] It also highlights how these risks may be transmitted to the financial system.

Recommendation 1 – Determine how climate and nature-related financial risks transmit to the economy and financial sectors in their jurisdictions and identify the risks that are likely to be material for the supervised entities.

1.1 Definition of climate and nature-related risks

Climate-related financial risks are a subset of nature-related financial risks and refer to financial risks arising from the exposure of financial institutions to physical or transition risks associated with climate change specifically.[4] Climate-related physical risks may be acute (resulting from the increased frequency and severity of climate-related events, such as floods, storms, or heatwaves) or chronic (arising from gradual changes in climatic conditions, including rising temperatures and sea levels).[5] Climate-related transition risks stem from the process of adjustments towards a lower-carbon and sustainable economy. These risks may result from changes in public policies, technological developments, consumer preferences, or investor sentiment. While climate-related risks are often treated by supervisors as a distinct category, they are intrinsically connected to broader nature-related risks (Section 1.3).

Nature-related risks serve as an umbrella term, subsuming both climate-related and other, broader nature-related risks, including those arising from biodiversity losses, soil erosion, and water pollution (NGFS, 2024a). They refer to potential adverse impacts of these risks on economies, individual financial institutions, and the financial system. Nature-related risks may arise from physical risks, resulting from the degradation of nature and the loss of ecosystem services, or from transition risks, stemming from adjustments associated with actions to protect, restore, or sustainably manage nature. Physical risks may be chronic (resulting from long-term environmental changes and ecosystem degradation such as soil degradation, declining water quality) or acute (arising from sudden and severe disruptions to ecosystems, biodiversity or natural resources) (NGFS, 2022). With respect to transition risks, scientific literature identifies five main drivers of nature loss: changes in land and sea use, overexploitation of natural resources, climate change, pollution, and invasive species (IPBES, 2019). Measures addressing these drivers – including public policies, legal precedents, technological developments, shifts in consumer preferences and changes in market sentiments – may generate transition risks for financial institutions.

Environmental risks refer to all physical and transition nature-related risks, excluding those related to climate change. They are synonymous with "broader nature-related risks".

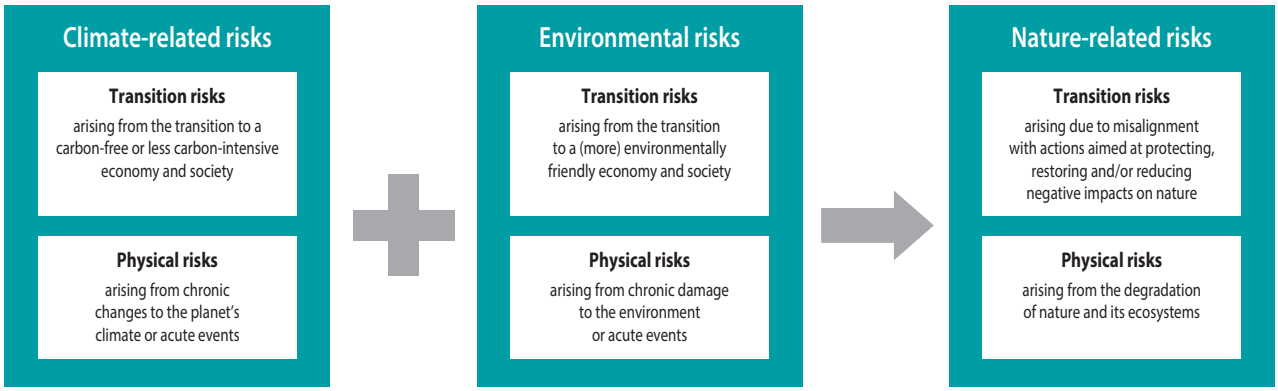
The Guide will frequently refer to "climate and nature-related risks" without implying any double counting of risks. This terminology serves two purposes. First, it acknowledges the substantial body of work already developed by supervisors on climate-related risks, which is generally more advanced than current work on nature-related risks. Second, the use of the term "nature-related risks" ensures that the broader scope of risks arising from

3 In alignment with (NGFS, 2020) recommendation #1: "Supervisors are recommended to determine how climate and nature-related risks transmit to the economies and financial sectors in their jurisdictions and identify how these risks are likely to be material for the supervised entities."

4 For simplicity, "climate-related financial risks" and "nature-related financial risks" will be referred to as "climate-related risks" and "nature-related risks" respectively in the remainder of this Guide.

5 Chronic climate-related physical risks may also result from the indirect effects of climate change such as loss of ecosystem services (BCBS, 2021).

Figure 2 **Definition of climate and nature-related risks used in this Guide**



Source: Authors.

nature degradation are included, as well as the often-overlooked interactions between climate change and other dimensions of nature. Adopting both terms therefore helps recognise existing supervisory practices mainly developed for climate, while promoting a more comprehensive understanding of nature-related risks (NGFS, 2024a). It stresses the importance of the interconnections between climate and broader nature-related risks ("climate-nature nexus"). The issues broached in this Guide might translate into climate-related examples and practices without having a broader-nature equivalent, most likely due to the more nascent character of the study of nature-related risks. Whenever this is the case, the reader may find that comparable nature-related supervisory practices remain less developed at this stage.

While the NGFS provides the definition used in this Guide, it recognizes there are different possibilities for definitions that are valid and serve the same end. The Guide is intended to serve supervisors regardless of the specific jurisdictional definitions or terminologies chosen. Given the implications of climate and nature-related risks for the financial system, supervisors have indeed developed definitions over time (Case study 1). Different approaches can be observed among supervisors: in some jurisdictions, references to international definitions such as by the NGFS sufficed, while in other settings – when formalizing supervisory requirements more strongly – formal definitions were introduced.

Case study 1: Supervisors' definitions of climate and nature-related risks

Malaysia	In the 2021 Climate Change and Principle-based Taxonomy (CCPT), **Bank Negara Malaysia** formally defined climate-related risks as manifesting in three dimensions of risk, namely physical, transition and liability risks (Bank Negara Malaysia, 2021). Bank Negara Malaysia further described them as risk drivers impacting commonly known risks managed by financial institutions, namely credit, market, liquidity, insurance, operational and strategic risks. In a joint study with the World Bank in 2022, Bank Negara Malaysia also explored nature-related risks in Malaysia, relying on a working definition of these risks: nature-related risks are risks related to ecosystem services, biodiversity, and natural assets, such as water and forests (Bank Negara Malaysia, 2022). They complement and partly overlap with risks from climate change within the environmental component of Environmental, Social and Governance (ESG) risks. Like climate-related risks, they manifest in the three dimensions: physical, transition, and liability risks. …/…

México	**Banco de México** has been referring to climate-related risks in its Financial Stability Reports since 2018, relying on international definitions and followed up on international developments by first reporting on nature-related risks in the 2024 edition of its Financial Stability Report, therein mentioning environmental and social risks (Banco de México, 2024). For the definition of nature-related risks through physical and transition risks, it cited the NGFS (NGFS, 2024a). Beyond its Financial Stability Reports, Banco de México requires the inclusion of climate and environmental risks in risk management concerning derivative transactions, without formally defining these risks.
South Africa	The **South African Reserve Bank** relies on international definitions of climate-related risks. The South African Reserve Bank's Prudential Authority issued a prudential communication in 2022 on climate-related risks (South African Reserve Bank, 2022), leveraging the definitions of physical and transition risks provided by NGFS in their 2019 call for action (NGFS, 2019), and further citing Basel Committee Banking Supervision (BCBS) and International Association of Insurance Supervisors (IAIS). Also in later publications, such as guidance notes for banks and insurers on climate-related risks, the South African Reserve Bank's Prudential Authority continued leveraging the NGFS definitions.
Switzerland	The **Swiss Financial Market Supervisory Authority (FINMA)** initially relied on international definitions, then formally published its definition of climate and nature-related risks. First, FINMA started communicating on climate-related risks starting in 2019 (FINMA, 2019) and 2020 (FINMA, 2020), referred to international organizations such as the NGFS while not formally defining climate-related risks. In 2024, FINMA published its formal definition of climate and nature-related risks in the context of defining specific supervisory guidance (FINMA, 2024). Nature-related risks include climate-related risks and are defined as short-, medium- and long-term potential for direct or indirect negative financial effects on an institution resulting from its exposure to climate and other nature risks. Nature risks are categorized as physical risks arising from the physical effects of changes in nature and the associated impairments of ecosystem services, or transition risks arising from the transition to a sustainable economy. They are risk drivers that can reflect nature-related risks in existing risk types such as credit, market, liquidity, insurance, business, compliance, legal and reputational risks.

1.2 Transmission to the financial system

Climate and nature-related risks can affect the financial system through physical risks and transition risks. These risks can be transmitted to financial institutions through financial risk categories, including credit, market, liquidity, operational, and underwriting risks. Table 1 illustrates how physical risks and transition risks may impact these risks.

A subcategory of these standard categories of financial risks may arise from litigation risks. Climate and nature-related legal cases have increased significantly in recent years, creating potential financial and reputational risks for financial institutions (Technical box 1).

Table 1 **Transmission of physical and transition risks through financial risks**[1]

Risk category	Transmission of physical risks	Transmission of transition risks
Credit risk	Physical risks, such as floods, storms, droughts, loss of pollination or water scarcity may damage the assets of borrowers, policyholders and counterparties. They may also disrupt production, reduce revenues and ultimately impair debt-servicing capacity. This may increase probabilities of default and credit losses.	Policy changes, technological shifts, and changing consumer preferences may reduce the profitability and creditworthiness of firms. They may also increase operating and compliance costs. This can lead to higher default risk and credit losses for the exposed sectors, such as agriculture, energy or transport.
Market risk	The value of securities, real estate assets, infrastructure investments and other financial assets may decline following climate or nature-related events. Insurers may also experience losses on their investment portfolios.	Financial markets may reprice assets exposed to transition risks, including equities, bonds and other instruments linked to carbon-intensive sectors or exposed to nature regulation. Revaluation may occur abruptly if markets reassess future cash flows or regulatory risks.
Liquidity risk	Extreme weather or water stress events can generate liquidity pressures for banks through increased credit demand, deposit withdrawals, or market disruptions. For insurers, large catastrophe events may lead to exceptionally high claim payments and increased liquidity needs.	Abrupt changes in investor sentiment or market expectations may trigger capital outflows, reduced market liquidity and higher funding costs for institutions exposed to transition risks.
Operational risk	Physical damage to branches, offices, data centres, communication networks or critical infrastructure may disrupt financial institutions' operations. Business continuity may also be affected by disruptions experienced by suppliers, service providers and clients.	Institutions may face legal, compliance and reputational risks associated with climate and nature-related regulations, disclosures, litigation or failures to adapt business practices to evolving environmental guidance.
Underwriting risk	Increasing frequency, severity, or geographical concentration of natural hazards may lead to higher claims and changes in the insurability of certain risks.[2]	Transition-related changes in technologies, regulations and business models may alter the risk profile of insured activities and affect future claims patterns and product demand.

1 Transmission of climate-related risks also encompasses sovereign-financial sector interconnectedness. In jurisdictions with a strong sovereign-bank nexus, climate-related shocks may not only weaken sovereign fiscal positions and affect the financial sector directly but also trigger adverse feedback loops between the sovereign and financial sector (World Bank Group, 2024a).

2 The insurance protection gap may worsen these pressures, as a large share of hazard-related losses remains in the real economy, thereby increasing underwriting risks. Globally, about 45% of disaster losses were insured in 2022, leaving a significant share of the shock to be absorbed by households, firms, and public finances.

Source: Authors.

Technical box 1

Climate and nature-related litigation risk: Relevance for banks and insurance companies

Climate and nature-related litigation risk is a source of financial risks for banks and insurance companies, which supervisors need to understand and address (NGFS, 2023b; NGFS, 2024b). Litigation risk[1] – also referred to as liability risk – was identified in 2015 as a channel through which climate change can affect financial stability, in the context of Mark Carney's speech 'Breaking the tragedy of the horizon' (Bank of England, 2015). In the intervening decade, the number of climate and nature-related litigation cases has grown exponentially, starting with challenges brought against states and public authorities, and expanding to cases against companies in a wide range of sectors, including fossil fuel and energy, transport, construction, agriculture and food, plastic producers, and finance (Grantham Research Institute, 2025).

…/…

1 Climate-related litigation refers to cases before judicial and quasi-judicial bodies that involve material issues of climate change science, policy or law. Nature-related litigation encompasses a broader range of strategic cases, focusing not only on climate, but also on biodiversity loss and the degradation of ecosystem services.

Litigation risk can affect banks and insurance companies through various costs (including compliance, legal, insurance, and fines) and can also pose reputational risks (NGFS, 2023c). First, litigation against states and public entities can potentially accelerate the materialisation of transition risks through adoption of and implementation of additional or stringent policy measures, thereby increasing compliance costs for affected firms. Second, litigation against banks or insurance companies may result in direct legal and financial costs (such as impacts from legal defense costs, damages, fines and other administrative sanctions) and indirect financial consequences (such as reduced revenues due to reputational damage, deterioration in credit worthiness, higher financing costs and insurance costs, and adverse effects on market valuation) (Green Finance, 2020; ECB, 2023; Grantham Research Institute, 2023; Bank of England, 2022). Third, litigation can impact not only the defendant but can have spill-over effects on other companies in the same sector, along with other institutions with financial exposures to the defendant, including financial institutions. Several cases have already been taken directly against banks in Europe. In France, non-governmental organisations (NGOs) have taken two separate cases against a French credit institution under France's corporate due diligence legislation. The first case concerned a bank's financing of new fossil fuel projects, where the claimants argued that the bank's 'plan of vigilance' failed to assess, disclose and mitigate the social and environmental impacts of its investments.[2] The second case challenged the bank's due diligence processes, claiming that it failed to prevent human rights violations through the alleged financing of companies involved in deforestation in the Amazon.[3] In the Netherlands, an NGO has launched a case against a bank, building on successful cases against the Dutch state, and against a fossil fuel company, to argue that the bank's inadequate climate actions constituted an unlawful breach of its societal duty of care under Dutch law.[4] The claimants requested that the bank establish a climate policy in line with the 1.5 °C target of the Paris Agreement, including reducing scope 1, 2 and 3 emissions. As of 2026, these cases are still pending before the national courts.

Despite these high-profile challenges, further work may be needed to raise awareness of climate and nature-related litigation risk among banks, and to ensure appropriate risk management. A recent study of European banks suggests that while many banks now recognise climate-related litigation risks as material, they are often not specific about how such risks are anticipated to manifest, including what types of litigation are likely to be impactful. Banks largely focus on compliance-related risks (fines) or liability linked to greenwashing, which may result in banks underestimating the potential impact of other forms of litigation. While banks are making progress in enhancing their risk identification and risk assessment, the risk mitigation remains comparatively underdeveloped (CETEx-LSE, 2025a).

Climate and nature-related litigation can also impact the insurance sector. Insurance companies might be subject to higher claims under liability policies, like directors and officers, professional indemnity, and third-party environmental policies (EIOPA, 2021). They are also exposed to accusations of greenwashing (EIOPA, 2024). Disputes can arise over policy exclusions or limits, stranded assets, settlement times under operational stress, failures in managing or disclosing ESG and climate-related risks, inadequate integration of climate-related risks into governance frameworks or related models, or disputes concerning access to insurance products in high-risk areas (IVASS, 2025). Climate litigations can affect insurance companies themselves: a prominent example was a case in the United States, where a fossil fuel company unsuccessfully brought an action against its insurer for refusing to defend and indemnify the company in underlying climate change cases.[5] Insurance companies may also initiate subrogation claims against third parties to recover their losses.[6] Other financial institutions have also been subject to judicial challenges and/or complaints

…/…

2 France (Notre Affaire à Tous Les Amis de la Terre, and Oxfam France v. BNP Paribas).

3 France (Comissão Pastoral da Terra and Notre Affaire à Tous v. BNP Paribas).

4 Netherlands (Milieudefensie v. ING Group and ING Bank).

5 US (Aloha Petroleum Ltd. v. National Union Fire Insurance Co. of Pittsburgh).

6 PG&E Insurance Subrogation Claims Relating to 2017 and 2018 Wildfires.

before national authorities, based on various legal bases, including greenwashing,[7] anti-money laundering,[8] and shareholder rights.[9]

An additional emerging dimension of litigation concerns disputes over the design and implementation of projects that are framed as supporting decarbonisation or climate resilience objectives. Such litigation targets the way in which transition-related activities are carried out, particularly in relation to large-scale infrastructure[10] and energy projects.[11] In developing markets, such cases expose deeper structural tensions between climate objectives and environmental, biodiversity, and community impacts. Projects intended to advance the transition may entail significant ecological trade-offs or procedural deficiencies, giving rise to legal challenges. For banks and other financial institutions, this broadens the scope of potential litigation exposure and underscores the importance of enhanced due diligence, including the integration of local environmental risks, cultural heritage considerations and community rights into investment and financing decisions.

Financial impact stemming from nature-related risks (NGFS, 2024b; ECB, 2024a; ECB, 2025a) suggests that nature-related litigation may also become increasingly relevant for financial institutions in the short to medium term. For these reasons, banks, insurance companies and their prudential supervisors need to continue their efforts to understand, monitor and manage the risks arising from climate and nature-related litigation.

7 France (ClientEarth v. BlackRock); Germany (Verbraucherzentrale Baden-Württemberg eV v. Commerz Real Fund Management S.à.r.l.); UK (Complaints to the ASA in respect of advertising by HSBC).

8 France (Sherpa v. BNP Paribas, Crédit Agricole and Others), UK (GLAN and London Metal Network v. London Metal Exchange).

9 Australia (Catherine Rossiter v. ANZ Group Holdings Limited).

10 India (M. K. Ranjitsinh & Others v. Union of India).

11 Romania (Declic and Bankwatch Romania v. Răstolița Hydropower Project).

1.3 Climate and nature nexus: financial implications

Climate change and nature degradation are deeply interconnected processes, and their interaction can materially shape the risk profile of supervised institutions (NGFS, 2024a; NGFS, 2026a).[6] Considering climate and nature-related risks in isolation may underestimate their scale, persistence and transmission across the real economy and the financial system. These risks can reinforce and compound one another through cascading effects, both in terms of physical risk (for example, drought impacts may be more severe where water-related ecosystem services are under pressure, while flood losses may be amplified where natural buffers have deteriorated) and on transition risk (for example, where fragmented, delayed or siloed policy action may increase transition risk, raise costs for firms and households, and amplify spillovers to banks and other financial institutions). The NGFS stresses the importance of mapping how climate and nature-related risks develop and interact, as interconnected pathways can lead to non-linear and compounding financial effects (NGFS, 2023d).

Embedding the climate-nature nexus in supervisory frameworks may support a more comprehensive understanding of how these risks affect the safety and soundness of supervised institutions. It can also help identify emerging vulnerabilities at an earlier stage, particularly where interactions between climate and nature-related drivers give rise to non-linear, cross-sectoral, or cross-border effects.[7] This is increasingly important for forward-looking supervision in the context of intensifying environmental change. Looking ahead, scenario narratives should increasingly reflect the climate-nature nexus to capture systemic interdependencies, feedback loops, and risk amplification channels more fully (Chapter 3).

6 Other than these two main references, important considerations about the climate-nature nexus, including with regards to its link to tipping points and linearity or scenario narrative design, can be found in (NGFS, 2023d), CETEx-LSE (2025a) or (IMF, 2024).

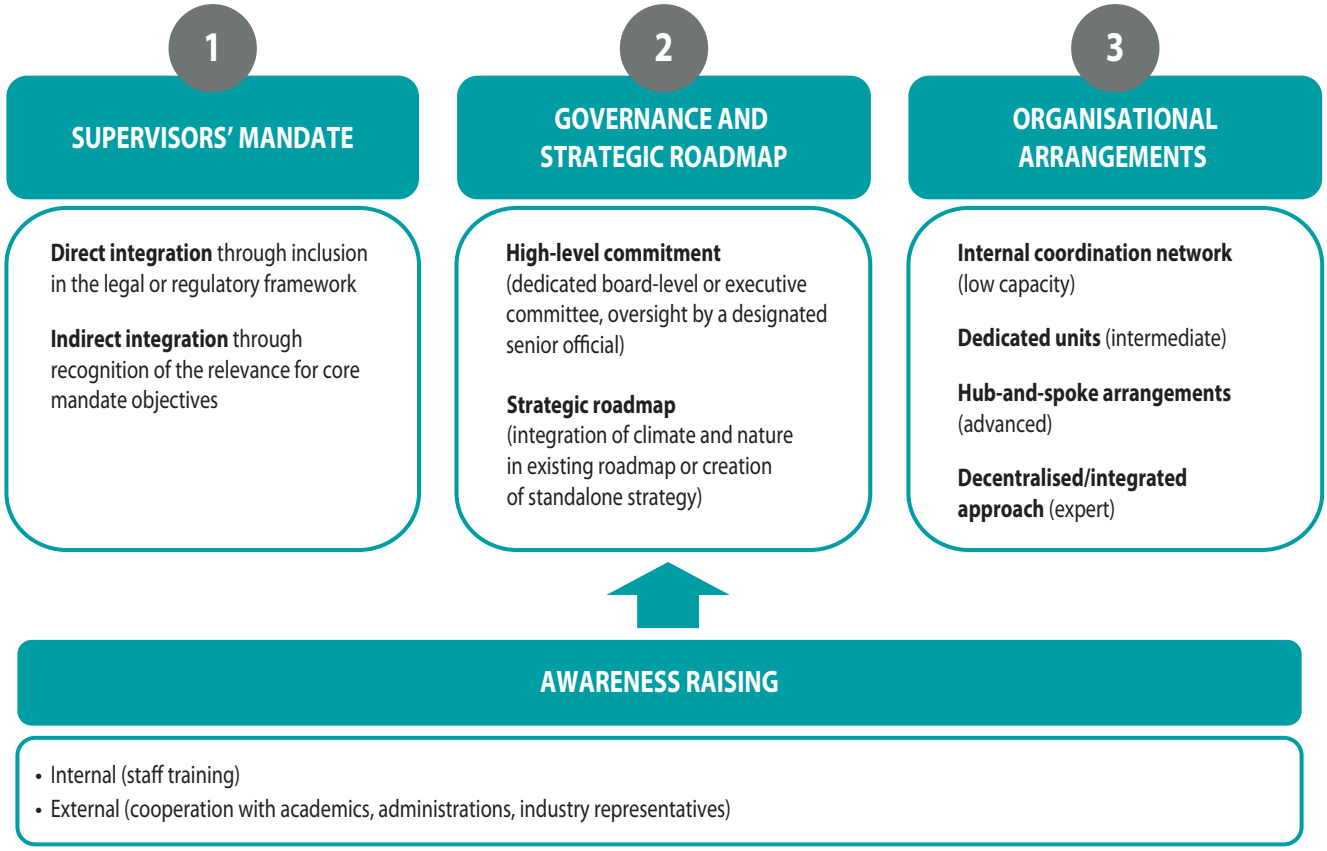
7 Considerations on the climate-nature nexus and how practitioners can refer to climate and nature risks collectively can notably be found in (CETEx LSE, 2025b; CETEx LSE, 2026a).

2. Awareness raising, organisational arrangements and capacity building for supervisors

This chapter lays out how the assessment of climate and nature-related risks can be integrated into supervisors' organizational structures. First, it shows how the assessment of these risks can be covered by the supervisory mandates. Second, it describes a high-level governance framework that can be put in place by supervisors, through the involvement of the board of directors and the steering of a strategic roadmap. Lastly, it highlights the possible organisational structures and actions of engagement with external stakeholders.

Recommendation 2 – Develop a clear strategy, establish appropriate organisational arrangements and allocate adequate resources to address climate and nature-related risks. Supervisors must consider the relevance of these risks within their mandates and support awareness-raising and capacity-building efforts across their organisations.

Figure 3 **Embedding climate and nature-related risks within supervisory organisations**



2.1 Supervisors' mandate

This section adopts a broad perspective to reflect the diversity of institutional arrangements across jurisdictions. References to central banks, supervisory authorities, mandates and supervisory actions encompass a range of governance models, including jurisdictions where supervisory responsibilities are exercised within the central bank and those where they are assigned to separate authorities.

Most supervisors have considered how climate-related risks fit within their mandates, whereas consideration of nature-related risks remains at a more nascent stage. Nevertheless, nature-related risks are increasingly gaining attention among central banks and supervisors. Initiatives have been launched to assess the relevance of nature-related risks from the legal mandate perspective, including analytical work by the European Central Bank (ECB, 2024b). In practice, supervisory actions related to nature are emerging in several jurisdictions, although public legal assessments specifically addressing the incorporation of nature-related risks into supervisory mandates remain relatively limited. Given the current state of development, this subsection focuses primarily on climate-related risks, while noting that many of the legal considerations discussed may also be relevant to the supervision of broader nature-related risks.

Considering the relevance of climate and nature-related risks within the context of supervisory mandates can support the development of supervisory approaches and provide a basis for supervisory action where appropriate. Supervisory mandates may address these risks either directly or indirectly. In the case of direct integration, legal or regulatory frameworks explicitly refer to climate-related risks or broader nature-related objectives. In the case of indirect integration, authorities recognize that climate and nature-related risks fall within the scope of supervisory mandates because of the potential impact on core policy objectives, including the safety and soundness of financial institutions, consumer protection and financial stability. Recognising climate-related risks within supervisory mandates – whether direct or indirect – is increasingly becoming the norm. According to the NGFS survey, most supervisors (77%) indicated that the assessment of climate-related risks was covered by their supervisory mandate, marking a significant evolution since 2020. Integration of climate-related risks within supervisory mandates may also strengthen supervisory accountability, as authorities can be increasingly expected to explain both their actions and any inaction in addressing these risks.

Indirect integration of these risks into the mandate may occur without amendments to legal texts. Assessing climate-related risk may be motivated by the objective of price stability, financial stability or individual institution's stability, or a combination of these. In such cases, and given the influence of climate change on macroeconomic variables**,** central banks and supervisors may recognise that monitoring climate-related risks falls within their mandate. For example, Section 224 of the South African Constitution instructs the **South African Reserve Bank** to protect the value of the currency in the interest of balanced and sustainable growth. Although this section does not explicitly mention climate change, climate-related risks are recognised as relevant to the SARB's mandate because they can affect price stability and sustainable economic growth through their impact on the economy and the financial system. Similarly, Section 3 of the Bangko Sentral ng Pilipinas Act defines price stability as the primary objective of **Bangko Sentral ng Pilipinas** (BSP), in support of "balanced and sustainable growth of the economy and employment". While Section 3 of the BSP Act does not explicitly mention climate change either, climate-related risks are recognised as relevant to the BSP's mandate because of their potential impact on price stability, economic growth and employment. In other jurisdictions, climate-related risk supervision is anchored in the financial stability mandate. **Banco de Portugal**, for instance, has recognised that climate-related risks may materialise through traditional systemic risk categories, thereby requiring coordinated micro-prudential and macro-prudential responses to preserve financial stability. **In some cases, explicit references in legal texts were introduced to enhance and reinforce existing prudential requirements.** For example, the capital requirements regulation[8] and directive[9] in Europe have been amended introducing explicit requirements for banks to manage ESG risks and for supervisors to assess these risks as part of the Supervisory Review and Evaluation Process (SREP).

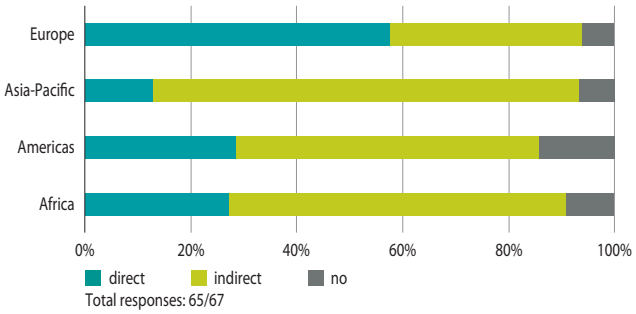
8 Regulation (EU) 2024/1623 of the European Parliament and of the Council (known as CRR3) amended the Regulation (EU) No 575/2013 as regards requirements for credit risk, credit valuation adjustment risk, operational risk, market risk and the output floor.

9 Directive (EU) 2024/1619 of the European Parliament and of the Council (known as CRD6) amended Directive 2013/36/EU as regards supervisory powers, sanctions, third-country branches, and environmental, social and governance risks.

The integration of climate-related risk considerations into supervisory mandates varies across jurisdictions. In Africa, Asia-Pacific and the Americas, climate-related risks are often addressed indirectly through central banks' broader objectives relating to price stability or financial stability. By contrast, in Europe, climate-related responsibilities are more frequently referenced explicitly within supervisory mandates and prudential legal frameworks. The NGFS does not take a position on whether climate and nature-related risks should be reflected explicitly or implicitly, nor does it suggest that one approach is preferable to the other. Rather, the NGFS encourages supervisors to consider how climate and nature-related risks are, or could be, captured within their existing mandates, given the potential implications of these risks for the financial system.

However diverse, supervisory mandates rest on common foundations provided by international standard setters (Section 4.1). Several such bodies have acknowledged the importance for supervisors to assess material climate-related risks, thus providing them with a mandate-aligned basis for action. In its principles for the effective management and supervision of climate-related risks, the **BCBS** highlights that banks are potentially exposed to climate-related risks through all traditional categories of financial risks, regardless of their size, complexity or business model (BCBS, 2022a). They may therefore continuously develop their capabilities and expertise on climate-related risks, and banking supervisors may, conversely, determine that banks' incorporation of material climate-related risks is sound and comprehensive enough. Likewise, as regards insurance, the **IAIS** notes that climate-related risks can impact the resilience of individual insurers, as well as financial stability (IAIS, 2025a).

Figure 4 **Direct or indirect references to climate-related risks in supervisors' mandate**



Source: NGFS Survey.

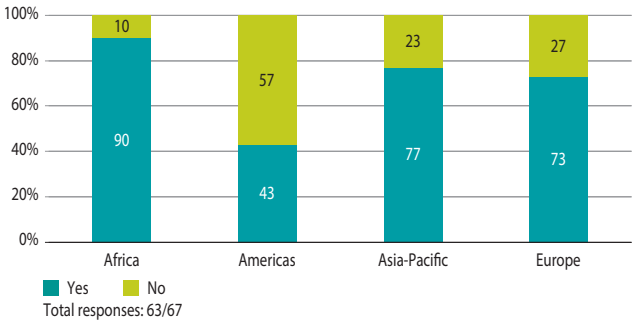
2.2 High-level governance and strategic roadmaps

High-level governance of climate and nature-related risk assessment helps ensure the strategic coherence of supervisory actions. The involvement of top management enables supervisory authorities to define a common vision and embed climate-risk supervision within their strategy, in line with their mandate. In practice, this high-level governance can take different forms. For example, some supervisory authorities have integrated climate and nature-related risks into their strategic plans, established dedicated board-level or executive committees, or designated senior officials responsible for overseeing climate-related supervisory work. For example, the **Monetary Authority of Singapore (MAS)** considers climate and nature-related risks through various established committees. Strategies to strengthen the climate resilience of the financial sector are tabled and discussed at the Green Finance Steering Committee, chaired by MAS's Managing Director. Climate-related issues that may have implications for financial stability and for the supervision and regulation of the financial services sector are deliberated at the Management Financial Stability Committee and the Management Financial Supervision Committee. More streamlined governance structures may involve appointing a dedicated lead, reporting to broader governance committees. This is the case, for example, at the **Swedish Finansinspektionen**, where the actions on climate-related risks are overseen by a dedicated Head of Sustainable Finance, who engages both internally and externally on these issues.

High-level commitment is generally articulated with the development of strategic roadmaps for addressing climate and nature-related risks. Roadmaps serve as a practical tool for translating strategic intent into concrete supervisory actions over time. They can help organise supervisory work and clarify roles and responsibilities across the organisation. Given their strategic dimension, roadmaps are generally formally endorsed by the board or senior management and regularly updated to reflect evolving priorities in line with the progress made. Supervisors may either develop dedicated climate strategies or embed these objectives within their broader strategic roadmap. For example, the **Hong Kong Monetary Authority** published a dedicated Sustainable Finance Action Agenda in October 2024, setting out both a vision

and concrete actions to consolidate Hong Kong's role as the region's sustainable finance hub (Hong Kong Monetary Authority, 2024). It provides the industry with forward-looking guidance with targets set for 2030 or 2050 (for example, all banks should strive to achieve net zero in their own operations by 2030 and in their financed emissions by 2050). Another example is the **Magyar Nemzeti Bank**, which published its Green Program in 2019, structured around three pillars: supporting initiatives for the financial system, developing professional partnerships, greening of its own operations (Magyar Nemzeti Bank, 2019). Alternatively, many supervisors have embedded objectives related to climate or nature-related risks within their broader strategic roadmaps. For example, the **Bank of Uganda**'s Strategic Plan 2022-2027 integrates elements dedicated to ESG and climate-related financial risks in the supervision and regulation of financial institutions. The **Banque de France**'s strategic plan for 2026-2028, named Cap innovation 2028, has integrated the assessment and monitoring of climate and nature-related risks into its overarching strategic plan. In total, 73% of the respondents to the NGFS survey have developed strategic plans to address climate-related risks, especially in Europe and Asia-Pacific. This indicates that climate risk management is becoming embedded as a core strategic priority for supervisors. The detailed version of these strategic roadmaps is generally kept internal, while the high-level principles are often disclosed through speeches or presentations to the press.

Figure 5 **Use of a strategic roadmap by supervisors**



Source: NGFS Survey.

Case study 2.1: Strategic roadmaps	
Singapore	The **Monetary Authority of Singapore** launched its roadmap in April 2023, which identifies the establishment of a climate resilient financial sector as a strategic outcome. The authority's approach focuses on uplifting environmental risk management practices in financial institutions through ongoing supervision and industry engagement, deepening climate risk assessment capabilities, and enhancing climate related disclosure standards to promote market transparency.
Tanzania	The **Bank of Tanzania** released a phased implementation roadmap covering the period from 2025 to 2029 to support the identification, assessment and monitoring of climate-related risks. The roadmap provides implementation timelines and transitional relief, allowing supervised banks and financial institutions, given their diversity in size, capacity, and business models, sufficient time to build the necessary institutional capacity and data collection capabilities for effective climate risk management. …/…

Jordan	The **Central Bank of Jordan**'s engagement with climate risk supervision was formalized with the publication of its Green Finance Strategy (2023-2028). This strategy sets out a comprehensive roadmap for developing sustainable finance in Jordan, including strengthening the management of climate related financial risks within the banking sector. It articulates high level objectives covering governance, risk management practices, data improvement, disclosure, and the development of green financial products. Importantly, the strategy explicitly links climate risk management to the Central Bank of Jordan's financial stability mandate, providing a clear institutional anchor for subsequent supervisory actions. To support implementation, the Central Bank of Jordan complemented its strategic framework with targeted capacity building initiatives. A notable example is the Green Finance and Climate Risk Management Seminar (2024), organized in collaboration with international partners, including the World Bank. This seminar brought together supervisors and financial institutions to deepen technical understanding of climate risk transmission channels, supervisory guidance, and emerging methodologies such as scenario analysis and stress testing. Such initiatives have played a critical role in translating high level commitments into operational knowledge, particularly in a context where both supervisors and supervised institutions are at an early stage of capability development.
Georgia	The **National Bank of Georgia** developed and released the Phase I of the Sustainable Finance Roadmap in Georgia along with its corresponding action plan in 2019. Over a five-year horizon, this roadmap served as the primary policy document aimed at providing a credible, predictable and stable regulatory framework. Its purpose was to prepare the market for transitioning towards sustainable finance and to facilitate the integration of ESG and sustainability considerations into financial decision-making by providing clear, internationally aligned regulations, policies, tools and guidelines. All actions that were defined under each pillar of the Phase I roadmap have been successfully implemented. In 2025, the National Bank of Georgia published the Sustainable Finance Roadmap for Georgia Phase II. It builds on the key directions outlined in the Phase I, while introducing additional pillars to address an expanded scope and evolving priorities.

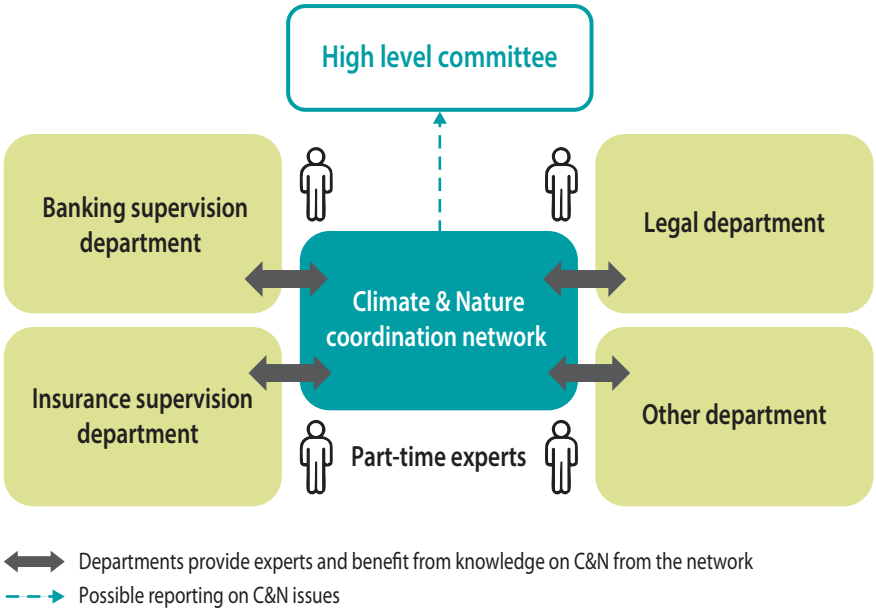
2.3 Organisational arrangements

Four main organisational approaches have been identified in supervisory authorities: internal coordination networks, hubandspoke arrangements, dedicated units, and fully integrated approaches. The first three structures were already identified in the 2020 Guide. NGFS Survey responses in 2026 suggest that these models remain relevant. In addition, a fourth model has emerged in practice: fully decentralised or integrated approaches. While survey results indicate variation in organisational configurations and resource allocation among supervisory authorities, there are signs of a gradual shift towards more formalised arrangements. A large majority of respondents report that responsibility for these risks has been assigned either to dedicated teams or to designated staff within existing departments, or that such arrangements are currently being developed. These structures can be classified according to their complexity as well as the level of resources and expertise they require. These structures are presented below. In practice, authorities can combine elements from several of these models. The departments mentioned in figures 5.1 to 5.4 only have an illustrative purpose and do not prescribe mandatory forms of organisation among supervisors.

- **Internal coordination networks (limited capacity and awareness-building):** Internal coordination networks typically represent an initial step in addressing climate and nature-related risks, relying on flexible and resource-efficient arrangements to facilitate cross-departmental collaboration. They enable supervisors to mobilise

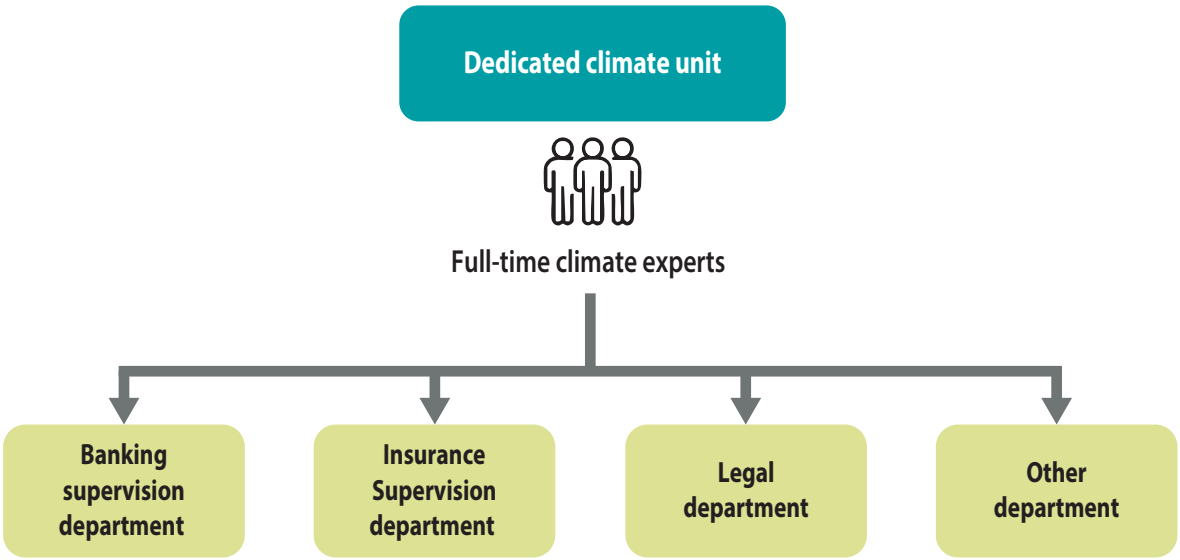
existing expertise and raise awareness across their organisation without requiring dedicated structures. This organisational arrangement functions as a mechanism for information sharing and coordination, and may report to the board, a steering committee, or a senior representative. Such networks may oversee either specific aspects (such as policy, research, or supervision) or all the various implications for the supervisor. In the latter case, departments participating in the network may include a wide range of business functions (supervision, policy, research, market operations, risk assessment, legal, communications, macroeconomics, analysis). In many cases, members contribute on a part-time basis while retaining responsibilities within their home divisions. In some authorities, this model serves as a transitional arrangement during the early stages of integrating climate and nature-related risks into supervisory practices. In other cases, it remains a permanent coordination mechanism alongside more formalised structures. However, such arrangements may present limitations in terms of clear ownership, consistency of implementation and the availability of dedicated resources.

Figure 5.1 **Internal coordination networks**



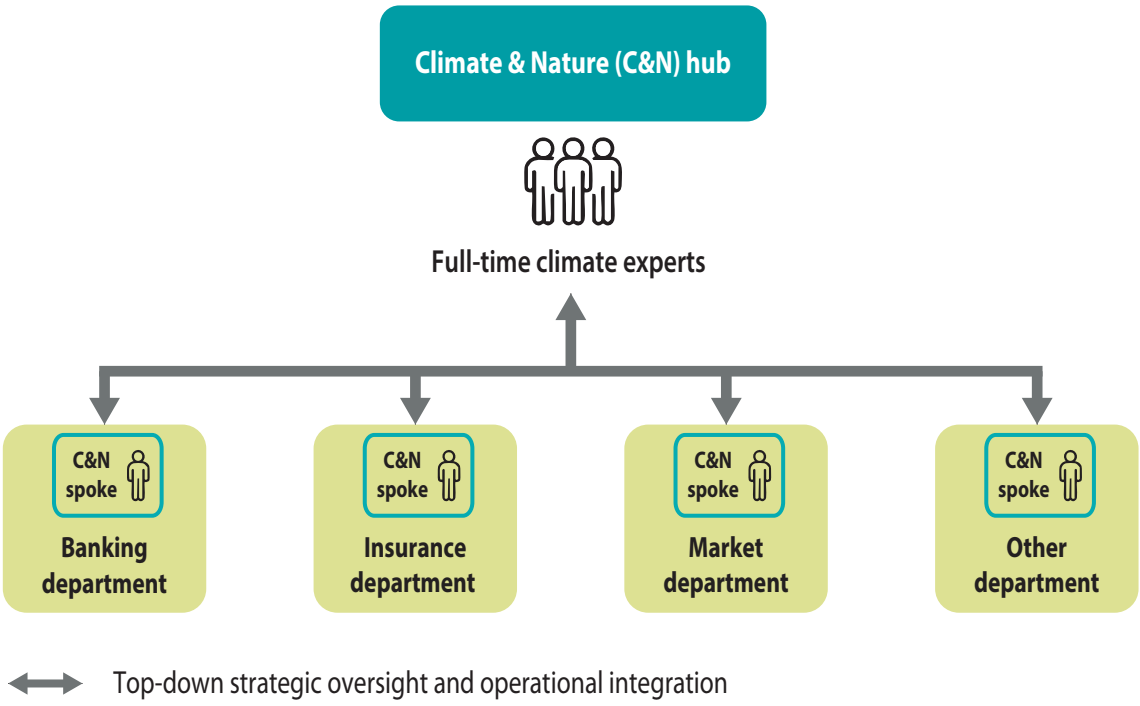
- **Dedicated units or specialised teams (moderate capacity and structured coordination):** Dedicated units constitute a more structured approach, with specialised teams working full-time on climate and nature-related risks. The dedicated unit becomes the main source of general expertise in climate and nature-related risk and coordinates the work across all divisions. In this design, the centralised team works full-time on climate and nature-related issues and risks. Such units can act as centres of expertise within the organisation and may be responsible for developing methodologies, coordinating supervisory initiatives, supporting policy development and engaging with international workstreams. The NGFS survey indicates that an increasing number of supervisory authorities have established such dedicated units. These teams can vary in size, ranging from small expert groups of a few staff members to larger divisions. Dedicated units are frequently located within financial stability, risk analysis or supervisory policy departments, reflecting the analytical and cross-sectoral nature of climate and nature-related risks. While this structure strengthens capacity and provides strategic focus, additional efforts may be required to ensure effective integration across supervisory functions and to avoid the emergence of silos between departments.

Figure 5.2 **Dedicated units or specialised teams**



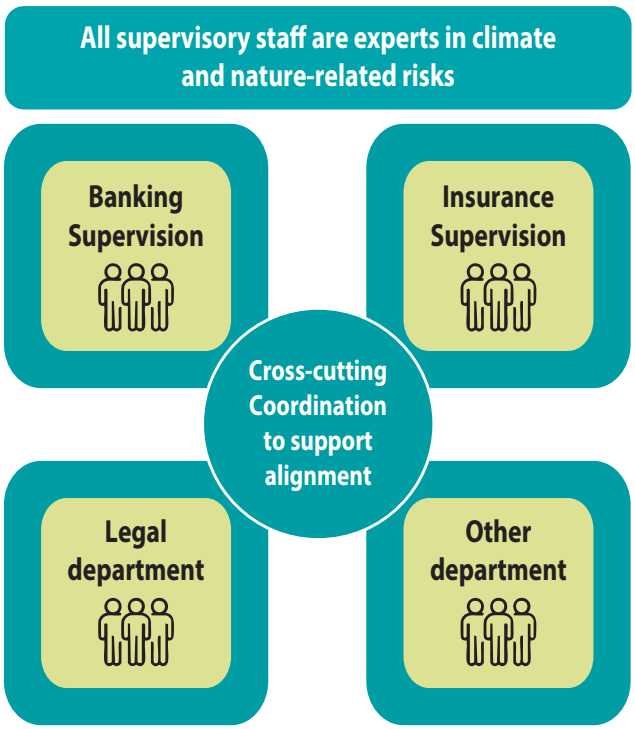
- **Hub-and-spoke arrangements (enhanced capacity and strong coordination):** Hub-and-spoke arrangements can be seen as a more advanced organisational model, combining a central team responsible for coordination and expertise with decentralised focal points embedded across supervisory functions. This model consists of a strategic central team (the hub) working full-time on climate and nature-related risks and a spoke in each division. In this design, the hub owns the overall climate and nature-related risk strategy and coordinates the work across the organisation. Survey responses indicate that the hub often acts as a centre of expertise responsible for developing methodologies, supervisory guidance and analytical tools, as well as coordinating climate stress testing and engagement with international initiatives. Each spoke may consist of several individuals that may be either dedicated to climate and nature-related risk work full-time, or – more likely – have a portion of their time dedicated to this work. The sector-specific spokes, typically embedded within banking, insurance or market supervision divisions, support the integration of climate and nature considerations into day-to-day supervisory activities. The hub-and-spoke structure can help ensure that climate and nature-related work remains coordinated at the organisational level while allowing individual departments to incorporate such considerations into their specific mandates and supervisory practices. This structure enables a balance between strategic oversight and operational integration, supporting consistency while ensuring that climate and nature-related risks are incorporated into day-to-day activities. However, this model requires robust governance frameworks to manage coordination across functions and maintain alignment.

Figure 5.3 **Hub-and-spoke arrangements**



- **Decentralised or integrated approaches (high capacity and specialised expertise):** In this configuration, supervisory authorities may adopt a fully decentralised or integrated approach in which climate and nature-related risks are embedded across all supervisory functions and processes. This model reflects a high level of institutional ownership and integration, as these risks become part of business-as-usual supervision. Under this model, responsibility for assessing such risks lies directly with existing supervisory or policy teams, without the establishment of a dedicated central unit. Climate and nature considerations are instead integrated into existing supervisory processes and risk assessment frameworks. However, the effectiveness of this structure depends on the existence of strong capabilities, expertise and adequate coordination mechanisms. Otherwise, there is a risk of fragmentation or uneven implementation across the organisation. Therefore, even within decentralised approaches, some authorities report the existence of horizontal coordination functions or focal points to support alignment across departments and to help ensure that climate and nature-related risks are considered systematically.

Figure 5.4 **Decentralised or integrated approaches**



2.4 Raising awareness of climate and nature-related risks

Supervisors have progressively increased their communication on climate and nature-related risks as well as collaborative actions to raise awareness among staff, financial institutions, and the wider public. The increased coordination of both internal and external initiatives represents a notable progression from the approaches set out in the 2020 Guide.

Comprehensive training for supervisory staff is essential to ensure they are equipped with the adequate skills, tools, and resources needed. NGFS survey responses indicate that supervisors have adopted a range of measures to enhance staff capabilities, including internal training programmes, participation in external courses, support for professional certifications or advanced academic qualifications. Collectively, these measures strengthen technical expertise while fostering a culture of continuous learning and adaptability within supervisory authorities. Common focus areas of the internal programme of supervisors include climate risk management, stress testing, and climate-related disclosures.

Supervisors may complement awareness-raising initiatives with structured knowledge transfer and institutional capacity-building arrangements. This may include the implementation of train-the-trainer programmes that enable supervisors to disseminate knowledge internally. In addition, technical assistance programmes should incorporate formal handover processes, comprehensive documentation, and succession planning to reduce reliance on external experts and preserve institutional knowledge despite staff turnover.

Cooperation with other administrations, academics or the industry plays a critical role in strengthening supervisory approaches to climate and nature-related risks. Governments are among the most frequent partners, reflecting the importance of inter-institutional coordination in developing national approaches. Research centres may also act as convening platforms for policy dialogue. A notable example is the work led by the Centro de Estudios Monetarios Latinoamericanos (CEMLA), the Association of Central Banks of Latin America and the Caribbean, which hosts specialised workshops that combine academic rigour with practical applications in this field. Among these, the Workshop on Climate Financial Risks, coordinated by CEMLA's Climate Financial Risks Centre and supported by the United Nations Environment Programme Finance Initiative (UNEP FI) through the Euroclima+ programme, promotes collaborative research projects aimed at developing and refining methodologies for assessing climate and nature-related risks.

Case study 2.2: Engagement with public administration and the industry

Mexico	The Sustainable Finance Committee, established under Mexico's Financial Stability Council, serves as the main coordination mechanism between financial authorities and financial institutions' representatives. This Committee has helped advance high-level strategic commitment to sustainability across the financial system. Through this platform, authorities have jointly supported the design and implementation of the Sustainable Finance Mobilization Strategy (EMFS), a government-wide roadmap launched in 2023 with the goal of mobilising up to 15 trillion Mexican pesos by 2030 toward climate and sustainability objectives. The EMFS reflects a board-level commitment by public financial authorities to integrate sustainability into core policy and supervision. **Banco de México**, as host of the Committee's secretariat, has promoted technical dialogue and capacity building across institutions, paving the way for coordinated, forward-looking action across the system. The Central Bank, together with the Ministry of Finance and through the Sustainable Finance Committee, led Mexico's first climate scenario analysis pilot with the participation of 10 financial institutions. As part of this effort, it collaborated with the National Autonomous University of Mexico (UNAM) to apply the CLIMRISK, which is an integrated assessment model – developed by UNAM – for assessing climate-related physical risks and their potential financial implications.

In recent years, supervisors have increasingly developed awareness-raising initiatives regarding nature-related risks. For example, actions drawn from international frameworks – such as the Task Force on Nature-related Financial Disclosure – are progressively being integrated into communications and training programmes. For example, the **European Central Bank** partnered with the NGFS on a Nature-related workshop in November 2025 – exploring, among other themes, the supervisory implications of nature degradation and how supervisors could include nature in their work. **Banque de France** also announced in 2026 the launch of a research chair dedicated to the macroeconomic modelling of nature-related risks. This chair brings together leading French research institutions, including Paris School of Economics. Such initiatives help strengthen and disseminate expertise on climate-related risks while also fostering a broader understanding of nature-related risks. Enhanced cooperation with peer jurisdictions, academic institutions, and other relevant stakeholders can further accelerate supervisory learning in this emerging field.

3. Assessing and quantifying climate and nature-related risks

This chapter presents a range of practices adopted by NGFS members to provide supervisors with guidance on how to identify, assess, quantify, and monitor climate and nature-related risks. It first describes the processes developed by supervisors to identify exposures to climate and nature-related risks and highlights the data required to conduct such assessments. Next, it outlines how supervisors may undertake both qualitative and quantitative assessments of climate and nature-related physical and transition risks. The chapter also discusses the development of key risk indicators at different stages of the supervisory process to support the monitoring of these risks. Finally, it sheds light on the use of scenario analysis and stress testing by supervisors.

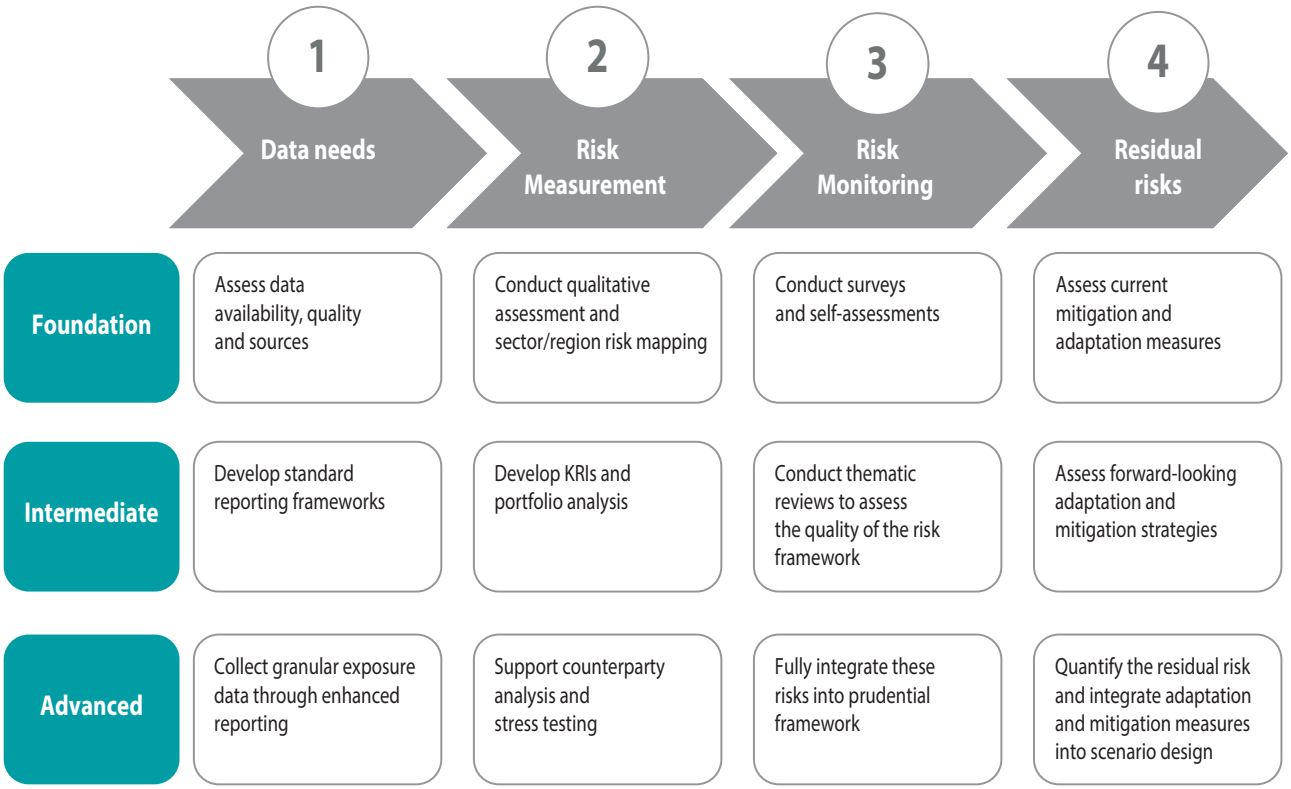
Recommendation 3 – Identify supervised entities' exposures to climate and nature-related risks, using qualitative and/or quantitative tools, and assess the potential losses arising from the materialisation of these risks.

3.1 Risk exposures, quality of control procedures and residual risks

The supervisory assessment of climate and nature-related risks is generally performed alongside three complementary dimensions:

- **Assessing risk exposures:** It refers to the assessment of exposures, vulnerabilities, concentrations, and transmission channels to which an institution is subject to before considering mitigation actions or controls. In other words, this corresponds to assessing the gross climate and nature-related risks to which the supervised institution is exposed.
- **Assessing the risk management framework, internal controls and governance:** It refers to the adequacy of the institution's governance, strategy, risk appetite, policies, data, methodologies, supervision, internal reporting and control framework. The supervisor assesses the adequacy and effectiveness of the supervised institution's risk monitoring and risk management procedures and mechanisms.

Figure 6 **Assessing and quantifying climate and nature-related risks**

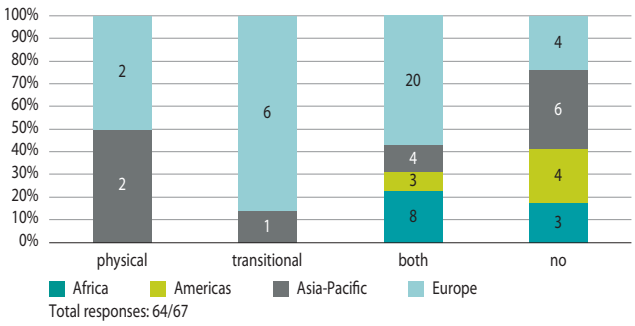


- **Assessing net or residual risks:** It refers to the risk remaining after taking into account mitigation measures, adaptation, insurance coverage, quality of guarantee, reinsurance agreements or other management actions. In other words, this corresponds to assessing the institution's net climate and nature-related risk, defined as the difference between its inherent (gross) risk exposure and the mitigating and adaptation measures put in place to manage those risks.

This distinction will also clarify how the different assessment tools, presented later in this chapter, relate to supervisory judgement. Heat maps, exposure mapping, and portfolio analysis primarily support the assessment of risk exposures; self-assessments, gap analyses and maturity assessments mainly inform the assessment of the risk management framework; and mitigation, adaptation, and insurance considerations help supervisors form an opinion on remaining risks. Finally, scenario analysis and stress testing can support all three dimensions, depending on their design and purpose.

Most supervisors adopt an integrated approach to the assessment of climate-related risks, encompassing both physical and transition risks. Based on the NGFS survey, 75% of the supervisors indicated that they have conducted a risk assessment at banking level for physical risk and/or for transition risk across all the risk categories (such as credit, market, operational, liquidity, strategic risk) for climate-related risks. The remaining 25% indicate that they are developing a framework to do so (Figure 6).

Figure 7 **Assessment of climate risk exposures of supervised financial institutions across risk categories**



Source: NGFS Survey.

3.2 Stocktake of data needs

Effective supervision and risk assessment rely on high-quality and comparable data. Taking stock of available data and identifying limitations is a foundational step for supervisors when assessing the climate and nature-related risks of supervised financial institutions. These data can support both qualitative and quantitative assessments, as well as the three categories of supervisory assessment presented in Section 3.1.[10] In practice, supervisors already rely on a broad range of data sources to support their analyses, including:

- **Geographic and sectoral exposure data**, breaking down loan and investment portfolios by geography and sectors, which allows assessment of concentration risks. Some progress has been made by supervisors in the collection of sectoral and geographic exposure data, including on borrower and collateral-location data using postal-code or municipal-level information.
- **Greenhouse Gas (GHG) emissions data**, covering Scope 1, Scope 2, and Scope 3 emissions. These data can be obtained from company disclosures, including through initiatives such as CDP (ex-Carbon Disclosure Project; Technical box 3) or PCAF (Partnership for Carbon Accounting Financials), and proprietary data providers.
- **Nature-related data**, which helps to identify dependencies and impacts to biodiversity and ecosystem services. Supervisors may draw on overarching indicators to compare the scale of their exposure to several nature-related risks and on targeted indicators such as land-use, water-stress and ecosystem-service indicators. Supervisors have also collected a series of data such as nature impact data, energy consumption or efficiency data of real estate, sectors with high environmental impacts, and green loans (NGFS, 2026b).

10 To collect these data, supervisors may rely on their internal data sets and external data providers. Supervisors have developed internal and external tools to assist in the data sourcing, including climate-related data catalogues, ESG Data Hub, Green Dashboard, or Climate Risk Vulnerability Assessment (CRVA) index. Moreover, artificial intelligence, including machine learning, can be used to assist supervisors in sourcing data from published sustainability or annual reports of corporations and external data providers. Supervisors may also collect data from meteorological agencies, emissions databases, open-source climate datasets from environmental agencies as well as other public and private data providers. Supervisory progress in this area depends to a significant extent on the availability, sound governance and prudent use of sufficiently granular data, including sectoral, geographic and, where relevant, asset-level information, while acknowledging that the use of proxies may remain necessary in certain cases.

- **Financial performance and risk metrics**, such as credit ratings, default probabilities, and loss-given-default estimates are used to link climate and nature exposures to conventional financial risks and to assess their potential materiality for supervised institutions.[11]

Supervisors may use supervisory reporting templates and mandatory disclosures to collect relevant climate and nature data. This enables supervisors to gather information with sectoral breakdown of loans, investments or underwriting portfolios, and green finance. As an example, **Banca d'Italia**, together with the other members of the Sustainable Finance Platform, chaired by the Italian Ministry of Finance, has developed a voluntary reporting template for small and medium-sized enterprises (SMEs) to support the climate and energy risk data available to financial institutions. To strengthen data collection and identify new supervisory-relevant variables, supervisors have also considered sustainability disclosures based on ISSB standards, taxonomies, and Pillar 3 ESG frameworks. Malaysia's Climate Change and Principle based Taxonomy (CCPT) is integral to the key data improvement efforts of the **Bank Negara Malaysia**. The **National Bank of Romania** collects data on green loans following certain categories of activity financed and the European Taxonomy criteria. Supervisors in Europe follow ESG reporting and disclosures standards or requirements defined by European Supervisory Authorities. The introduction of mandatory disclosures can also support the collection of relevant data. Australia's regulatory framework for climate-related risk disclosure changed significantly in 2025 with the introduction of a mandatory climate disclosure regime through changes to the Corporations Act, and administered by the Australian Securities and Investments Commission (ASIC). Under this regime, based on the ISSB standards which were implemented through local standards, certain entities (including those regulated by the **Australian Prudential Regulation Authority**) are required to make climate-related financial disclosures in accordance with Australian law. Most banks will provide their first mandatory climate disclosures in 2026.

Supervisors may face material data gaps when assessing climate and nature-related financial risks. Supervisors may therefore adopt a phased approach, making use of alternative data sources, proxies (such as sectoral averages) and publicly available datasets. Supervisors may also focus initially on sectors, portfolios, and counterparties that are expected to be most exposed to these risks, while progressively enhancing data coverage and granularity over time. Engagement with financial institutions can help improve data collection practices, while collaboration with statistical agencies and international institutions may facilitate access to relevant datasets and methodologies. Although imperfect data should be interpreted with appropriate caution, data limitations should not prevent supervisors from undertaking risk assessments and building an initial understanding of potential vulnerabilities. Rather, supervisory approaches should seek to balance methodological robustness, while clearly acknowledging the uncertainties involved. Each jurisdiction can therefore, based on its own circumstances, gradually establish a data governance and sharing framework to support climate and nature-related risk assessments.

Figure 8 **Phased approach to overcoming supervisory data gaps**

11 An additional "low-data" toolkit to cater for many regions with high levels of informal sectors (e.g., SMEs, farmers etc.) could be also relevant. It includes metrics such as GPS coordinates for material collateral, satellite and open-source hazard data, loan-purpose codes, utility data, sector or district proxies.

Technical box 2

Supervisory use of climate and nature-related disclosed data from financial institutions

Financial institutions have voluntarily self-disclosed environmental risk information through CDP since 2020. These disclosures provide a source of granular data on how institutions identify, assess, quantify, and manage physical risks across their portfolios. This box summarises key insights from the 2025 disclosures of more than 480 banks, insurers and investors reporting to CDP's Financial Services questionnaire, highlighting available physical risk data, practice maturity across climate and nature themes, and data gaps relevant to supervisory materiality assessments.

Disclosure datapoints and supervisory use cases

Supervisory use case	Purpose	CDP Disclosure datapoint	% FIs – Climate	% FIs – Nature
Materiality screening: physical risk considered at firm level	Risk assessment	Environmental risk assessment in place for FI's portfolio activities	86	86
Scope of physical risk analysis for scenario design	Risk assessment	Considers both acute & chronic physical risks	67	33
Input into stress testing & resilience analysis	Scenario Analysis	Conducts scenario analysis incl. acute & chronic risks	58	9
Exposure identification: material risks with financial effects	Risk exposure	FI identified physical risks with current/anticipated financial effects	59	16
Inform scenario analysis and loss estimation	Risk exposure	Ability to quantify anticipated financial effects*	67	60

* Denominator is FIs that identified any material physical risks.

Disclosure rates are highest for disclosure datapoints related to risk identification, such as whether physical risks are considered at all or whether exposures are recognized. By contrast, disclosure rates are lower for disclosure datapoints requiring financial quantification, including estimates of anticipated impacts on revenues, assets or costs, and scenario analysis that consider both acute and chronic physical risks. Identification-level data supports materiality screening, peer benchmarking, and prioritization of supervisory engagement.

While nature-related disclosures have expanded following the development of frameworks such as the Task Force on Nature-related Financial Disclosures (TNFD), disclosure evidence suggests that approaches to identifying and managing nature-related physical risk exposures remain less developed and less consistently applied than those for climate-related physical risks. This points to an area where additional supervisory attention and capacity-building may be warranted.

Associating financial risk categories with disclosed *physical risks*[1]

Across disclosed physical risks, financial institutions frequently associate a single physical hazard with one or multiple traditional financial risk categories. This suggests that, at firm level, physical risks can be understood as having the potential to affect several parts of the balance sheet simultaneously.

Number of financial risk categories mapped to a physical risk	Share of disclosed physical risks (%)
One financial risk category	68
Two financial risk categories	16
Three or more financial risk categories	16

…/…

1 Percentages reflect the distribution of disclosed risks, not the share of institutions.

Just under one-third of disclosed physical risks (32%) are characterized as multichannel risks, providing an empirical basis for considering the potential for compounding effects across traditional financial risk categories. Within these disclosures, credit and insurance risks are most frequently cited, followed by market and operational risks, reflecting the balance sheet channels institutions most commonly associate with physical hazards.

Physical hazards and associated financial risk categories[2]

The heatmap highlights that no major physical hazard is associated with just one financial risk category in isolation. Flooding-related risks are most frequently linked to credit and insurance risks, reflecting anticipated impacts on collateral values, borrower repayment capacity and claims liabilities. Heat-related risks are more often associated with insurance and operational risks, including impacts on mortality, morbidity and productivity, while drought and water stress risks are predominantly framed through credit and operational channels. Market and liquidity risks appear less frequently but are present across most hazards, pointing to potential second-round effects.

Such information can complement supervisory analysis and stress-testing frameworks, with a view of the consistency between firms' internal risk mapping and supervisory views and identify areas where certain channels may be under or overemphasized in institutions' own analyses.

For the 2026 cycle, CDP has refined questions to better distinguish physical risk responses and adaptation actions. Ongoing alignment with TNFD and NGFS-identified nature metrics will enhance the effectiveness of physical risk assessment, also in line with the G20 Sustainable Finance Working Group priorities, especially noted in the 2025 Presidency and Co-Chairs Report. Overall, voluntary climate and nature-related disclosures already provide supervisors with useful contextual information to supplement identification of vulnerable exposures and potential loss channels – complementary to, but not a substitute for, supervisory scenarios and analytical tools.

Physical risk driver	Credit	Insurance	Market	Operational	Liquidity	Capital/RWA
Flooding	25%	20%	12%	20%	8%	4%
Heat stress/temp. var.	15%	25%	10%	15%	6%	7%
Drought/water stress	27%	1%	13%	22%	5%	3%
Wildfires	24%	16%	12%	20%	8%	4%
Changing recipitation	22%	9%	13%	19%	6%	3%

2 Figures show the share of financial risk mappings associated with each physical hazard. One physical risk may map to multiple financial risk categories; totals therefore exceed 100% across columns.

3.3 Qualitative assessment of climate and nature-related risks

Qualitative assessment tools provide a practical starting point for assessing climate and nature-related risks, particularly where data and modelling capabilities remain limited. They help financial institutions and supervisors – through their own analysis or by analysing information provided by supervised financial institutions – to identify material exposures and understand key vulnerabilities for further analysis. The qualitative tools presented below are arranged in order of increasing complexity.

1. Heatmaps and exposure mapping: Heatmaps and exposure-mapping exercises provide an initial assessment of concentrations of climate and nature-related risks across portfolios, sectors, counterparties and geographic regions. Institutions may classify exposures according to their sensitivity to climate physical and transition risks or dependencies on ecosystem services using simple risk ratings. Typical data inputs include sector classifications (such as NACE codes, ENCORE mapping), portfolio exposures, counterparty information and asset location data. The objective is to identify and visualise concentrations of exposures to climate or nature-sensitive sectors, regions, assets or counterparties. These exercises support supervisors' assessment of financial institutions' gross risk exposures, including their vulnerabilities, risk concentrations, and potential transmission channels.

2. Self-assessments and gap analyses: Self-assessments and gap analyses evaluate the extent to which climate and nature-related risks are incorporated into governance, strategy, risk management, data frameworks and disclosures. They enable institutions and supervisors to benchmark current practices against regulatory guidance and identify areas requiring remediation. These assessments may rely on internal documentation, including risk policies, disclosure reports, audit findings, sustainability strategies, board and committee minutes, risk appetite statements, and documentation of internal control frameworks. Supervisors typically use interviews, surveys or data requests to seek information. Annex A lists key qualitative information which supervisors have typically asked as part of a supervisory survey. These self-assessments may then support supervisors in developing maturity assessments. To follow up on survey results, supervisors either provide feedback on the findings to the individual institutions or communicate aggregate findings to the sector at large or a combination of both. The examples in Case study 3.1 below serve to illustrate possible avenues to present a diagnosis of the sectors as a whole based on individual survey results.

3. Portfolio vulnerability analysis: This assessment combines sectoral vulnerability analysis with expert judgement to evaluate the vulnerability of economic sectors, business models or counterparties to climate and nature-related drivers. Examples include exposure to carbon pricing, technological change, water scarcity, biodiversity degradation, deforestation regulations and ecosystem service disruption. They are particularly useful where data gaps limit quantitative analysis and can help identify emerging risks that are not yet reflected in models. Inputs may include sector studies, transition pathways, scientific assessments, environmental indicators, policy scenarios, industry benchmarks and expert opinions. This assessment supports supervisors in identifying and evaluating gross risk exposures arising from sectoral vulnerabilities to climate- and nature-related drivers.

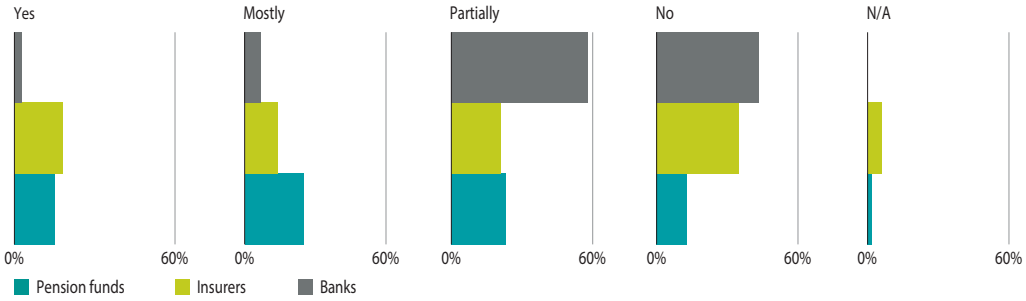
4. Scenario narratives and qualitative scenario analysis: Qualitative scenario analysis explores how climate and nature-related risks may materialise under alternative future pathways. Through expert discussions and narratives, institutions assess transmission channels, business vulnerabilities and strategic implications, providing a bridge between qualitative assessments and quantitative stress-testing exercises. Data requirements may include NGFS scenarios, biodiversity and ecosystem scenarios, macroeconomic assumptions, sector transition pathways, policy assumptions, portfolio exposures and expert judgement regarding risk transmission channels. They may support the assessment of both gross and residual risk exposures, where mitigation and/or adaptation measures are incorporated into the scenarios.

Case study 3.1: Presentation of survey results to the industry

Netherlands

De Nederlandsche Bank used a survey in 2021 to study how financial institutions incorporate sustainability risks into their core business processes, posing open-ended questions to 127 financial institutions (61 pension funds, 37 insurers and 29 banks) in its jurisdiction, representing approximately 95% of the Dutch financial sector by balance sheet value (De Nederlandsche Bank, 2021a). The report found significant progress in awareness and policy development, particularly regarding climate-related risks. However, the integration of sustainability risks into governance, strategy, risk management, and reporting frameworks remained uneven. Data limitations, methodological challenges, and uncertainty regarding long-term impacts continued to hinder effective implementation. As a result, De Nederlandsche Bank emphasized the need for financial institutions to further embed sustainability risks into their core decision-making processes and treat them as material financial risks rather than as a separate sustainability issue.

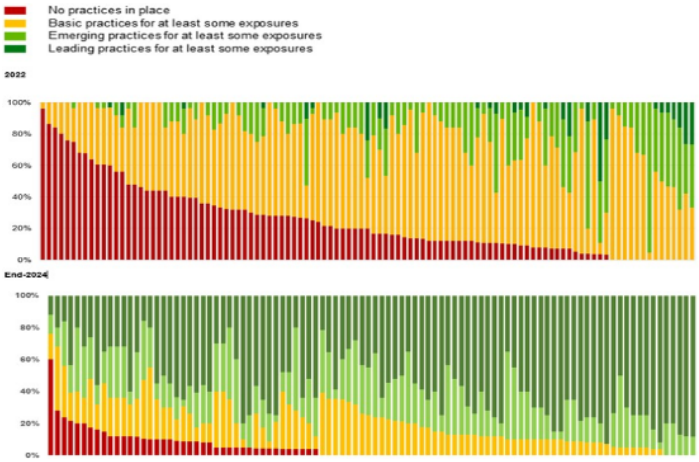
Extent of integration of sustainability risks in credit risk (banks) and market risk (insurers and pension funds)



Source: DNB.

European Union

The **European Central Bank (ECB)** conducted a supervisory assessment (including a self-assessment exercise) in 2022 where it asked banks to perform a self-assessment vis-à-vis its supervisory guidance on climate and environmental risks. To present an overview of the results, the ECB classified financial institutions in four categories, with definitions applicable to each question of the survey: (i) no practice, (ii) basic practice, (iii) emerging practice and (iv) leading practice. Following a series of supervisory exercises to ensure that financial institutions comply with its supervisory guidance, the ECB reassessed the performance of financial institutions and published an updated version of the graph on alignment with supervisory guidance. The classification reflects the maturity of practices, but not their coverage across all exposures. The figure below shows banks' alignment with ECB supervisory guidance on climate and environmental risks, in 2022 and at the end of 2024 (ECB, 2025b).



Focus on nature-related risks

Some supervisory authorities rely on self-assessment questionnaires on nature-related risks. For example, the **Bank of Mauritius** has evaluated the sensitivity of bank exposures based on information supplied directly by supervised institutions. Banks report observed losses and material exposures linked to nature-related risk drivers, providing supervisors with evidence of vulnerability channels.

Qualitative evaluation of economic dependencies on ecosystem services for physical risks, and the qualitative evaluation of environmental footprints for transition risks can also be conducted. Most authorities use the qualitative database ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) to determine how different sectors depend on key ecosystem services and to identify associated vulnerability channels such as water scarcity, land degradation, or deforestation. Some supervisors also assess the impact of economic activities on ecosystem services or biodiversity, highlighting transition risk dimensions. For example, they analyse the potential environmental impact of domestic economic activities to identify transition exposures. Unlike for physical risks, although the ENCORE database is also used by some jurisdictions to assess sensitivity to transition risks, a greater diversity of sources has been used according to the specific nature of transition risks in the jurisdiction.

Tools combining qualitative and quantitative inputs can be used. Supervisors may analyse the sensitivity of financial exposures to environmental shocks connecting the above-mentioned assessments to financial institutions' balance sheets. A common approach consists of portfolio-level sensitivity assessments based on ecosystem service dependency and impact. As an example, the **European Central Bank** calculated the share of euro area corporate loans extended to non-financial corporates that are highly dependent on at least one ecosystem service, identifying potential vulnerabilities concentrated in certain sectors and regions. It also conducted a transition risk-oriented sensitivity analysis by measuring the impact of euro area corporates on natural habitats – both domestically and globally through supply chains – to determine which environmental drivers (notably land use and climate change) are most material for the region. **Bank Negara Malaysia** has also performed an exploratory nature-related assessment linking bank lending to ecosystem service dependencies and impacts. Its joint work with the World Bank on extreme flood impact quantification provides evidence on how acute environmental shocks propagate to macroeconomic aggregates, credit risk, and insurance exposures – an important dimension of sensitivity analysis for environmental physical risks.

3.4 Quantitative assessment of climate and nature-related risks

Supervisors have developed quantitative analyses to assess the exposure of financial institutions to climate and nature-related risks. The sections below classify the approaches that supervisors have adopted based on the required data sources. The data sources used determine the precision of these analyses. The determinants to analyse the exposure to transition and physical risks resulting from climate change and to nature risks are set out separately below.

3.4.1 Physical risks resulting from climate change

Supervisors assess physical risk through (1) the vulnerability to climate hazards, (2) the geographical location of assets and (3) may also consider the interconnectedness of physical risks among financial institutions. A few supervisors have considered interconnectedness of physical risk, looking at how financial institutions can transfer these risks to other financial institutions or to what extent multiple financial institutions are affected by a single event.

First, vulnerability to climate hazards may materialise through both micro- and macroeconomic channels. At the micro level, they increase credit risk by degrading collateral values and reducing borrower repayment capacity of households, corporates, and sovereigns, disrupting business operations, increase liability and strain liquidity through unexpected increases in insurance claims pay-out (NGFS, 2026c). These shocks at the micro level occur against a broader macroeconomic backdrop. At the macro level, physical risks reduce economic output by impairing labour productivity, disrupting supply chains, and contributing to inflationary pressures and resource constraints. This, in turn, affects financial institutions' exposures across sectors and geographies. They also heighten market risk

through the potential for sudden asset devaluations and volatility, strain liquidity via deposit withdrawals or credit line drawdowns during disasters and disrupt operations by damaging infrastructure and systems.

Second, information about the specific locations of the financial institutions' assets, collateral, activities and insured lives or properties is required to assess their exposure to climate-related physical risks. Financial institutions themselves may struggle with assessing and managing physical risks due to limited transparency on counterparties' exposure and adaptation efforts. Thus, before approximating assets' individual physical climate hazards and vulnerability, supervisors may first need to map physical risk on country or regional levels. To handle these challenges, supervisors have adopted approaches with different degrees of sophistication and data granularity (Table 2). Assessing on a country level, **De Nederlandsche Bank** designed a vulnerability index, based on different variables, that considers both the effects of climate change as well as a country's economic resilience. De Nederlandsche Bank updated an indicator used by Standard & Poor's to country risk resulting from climate change (Case study 3.3).[12] Whereas an assessment on the country level provides a first heatmap of climate-related physical risks, supervisors are well-advised to develop more granular approaches over time to determine the magnitude of physical risks. At the advanced end, approaches demand availability of highly granular climate, facility location and balance sheet data and are expected to become more mainstream as disclosure frameworks evolve.

Third, supervisors would need to consider how financial institutions seek to mitigate individual physical risks through risk transfer mechanisms. While this may reduce exposures at the institution-level, the underlying physical risk may remain within the financial system. By contrast, adaptation measures can reduce the vulnerability of assets and thereby reduce the underlying physical risk. Thus, supervisors may want to get a more precise view of the ultimate bearer of these risks. For instance, if insurers raise premiums or restrict coverage in response to increasing physical risks, ultimately, the risks which they initially bore would be transferred to households, companies and lenders. Affordability and insurability are thus likely to become an increasing concern in a climate change context and will widen the protection gap (IAIS, 2023). Some supervisors have already shown that the absence of insurance coverage can have an impact on the exposure of the banking sectors to climate-related risks (Autorité de Contrôle Prudentiel et de Résolution, 2019). Some physical risks remain poorly insured despite their significant impacts. Between 2012 and 2022, insurance covered only 5% of economic losses from floods in emerging markets, compared with 34% in advanced economies (Swiss Re, 2022). Credit losses for banks could be bigger if these losses are uninsured. For the insurance sector specifically, assessing exposure to physical risks on the liability side is also an important consideration. Insurers' exposures on the liability side correspond to underwriting risks, such as non-life insurance claims arising from extreme weather events (IAIS, 2025b). EU insurance supervisors monitor compliance with the capital requirements for these activities as set out in the Solvency II framework. Some regulators, as reflected in the 2026 survey, have additionally chosen to explore the sector's resilience through dedicated stress-testing exercises.

Based on these analyses, supervisors have started to define Key Risk Indicators (KRIs) to monitor the development of climate-related physical risks on the financial institutions they supervise. This includes:

- the countries vulnerable to climate change (according to the ND-GAIN Index or Standard & Poor's methodology) in which their activities are located; and
- the exposure of financial institutions and households to physical risks (in particular, flood risk).

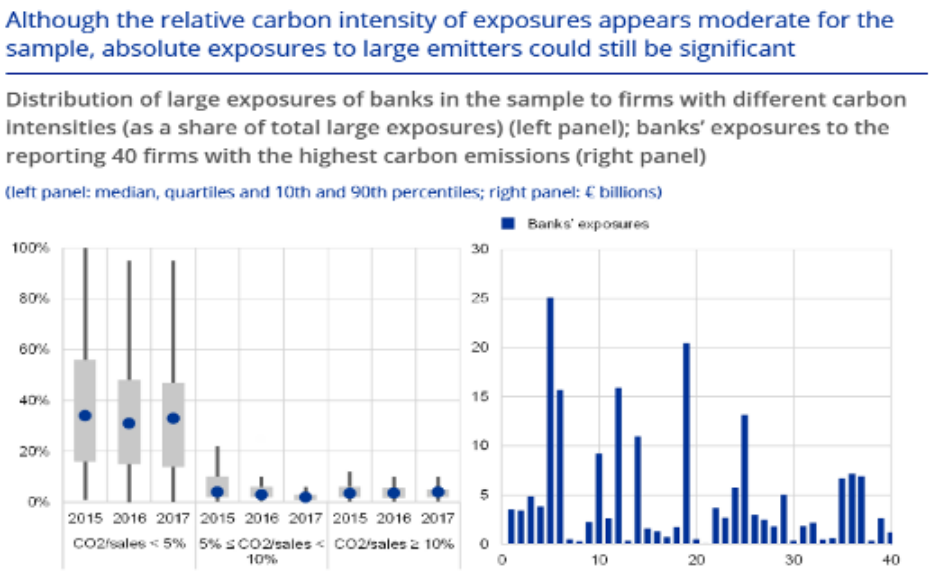
12 The indicator is based on the following three parameters: (1) The Notre Dame University Global Adaptation Index (ND-Gain Index). This index comprises a total of 36 variables, which in determining the impact take into account both the effects of climate change, as well as the economic resilience of countries. (2) The percentage of the population that live in areas where elevation is below 5 meters, as an indicator of the vulnerability to rises in sea level and flooding. Derived from World Bank data. (3) Agriculture as a percentage of gross domestic product. Derived from World Bank data.

Table 2 **Approaches to assess physical risk (based on geographical location of financial institutions, their exposure and collateral)**

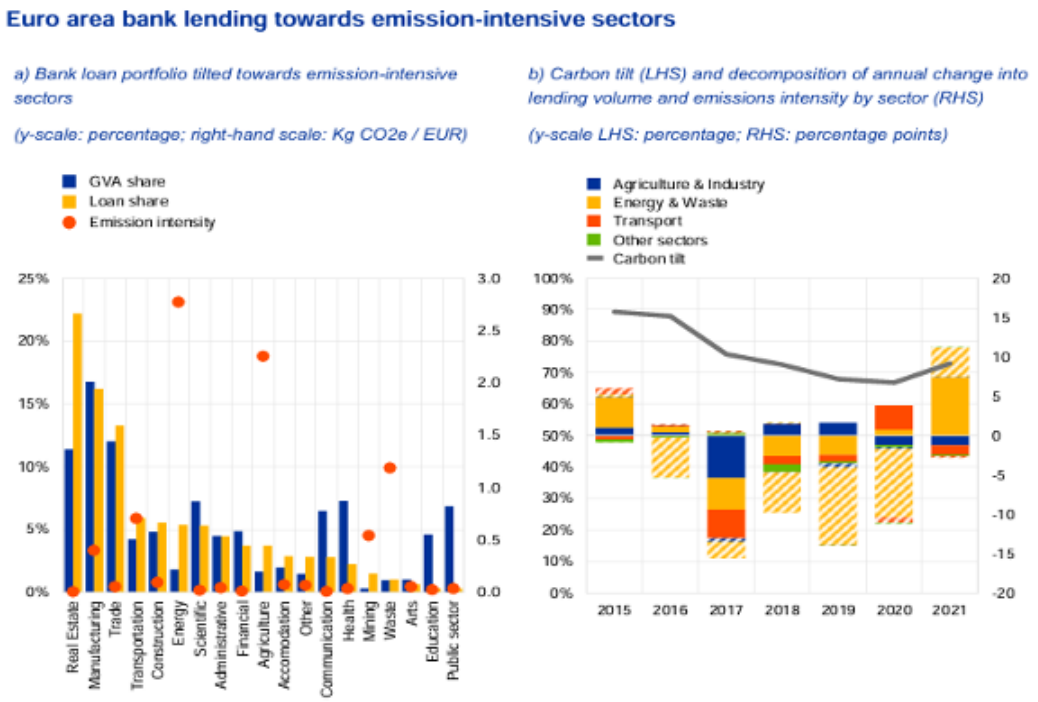
Level of granularity	Approach	Data needs on the balance sheets	Climate-related data needs	Examples
Low	Country-level *(publicly available information)*	Country exposure	Vulnerability to physical climate impacts per country (i.e. ND-GAIN country index)	De Nederlandsche Bank, Waterproof? – An exploration of climate-related risks for the Dutch financial sector, 2017, figure 1 and 2. Autorité de Contrôle Prudentiel et de Résolution, French insurers facing climate change risk, 2019, p. 8. IAIS, Global insurance market report, The impact of climate change on the financial stability of the insurance sector, 2022.
Medium	District-level *(publicly available information)*	Location-specific exposures (i.e. coordinates of facilities, assets)	Vulnerability to physical climate impacts per district	Bank of England, flood risk mortgages, box 6, 2018. Banca d'Italia, Natural catastrophes and bank lending: the case of flood risk in Italy, 2018. Banca d'Italia, The exposure of Italian manufacturing firms to hydrogeological risk, 2024. Banco Central do Brasil, Financial Stability Report, 2022, section 2.2. Banco de Mexico, Financial Stability Report, 2025, section IV.4. Bangko Sentral ng Pilipinas, Impact of Extreme Weather Episodes on the Philippine Banking Sector, 2020.
High	Facility-level *(counterparty disclosures)*	Location-specific exposures (i.e., coordinates of facilities, assets)	Vulnerability to physical climate impacts per geographical location	De Nederlandsche Bank, Values at risk, para. 4.1 (only 2,000 largest companies), 2019. Banque de France, Responsible Investment Report, 2018, p. 25. De Nederlandsche Bank, Mapping Physical Climate Risk Exposure in Euro Area firms: Linking E-PRTR and RIAD with a Fuzzy Match, 2025.
High	Value chains (both upstream and downstream) *(counterparty disclosures)*	Data on physical climate risk exposure of the value chain/location-specific data for vulnerable producers, suppliers, aggregators and distributors etc.	Input-Output tables or more detailed supply chain data	

Case study 3.2: Example of exposure analysis to transition risk

In its Financial Stability Review (ECB, 2019), the **ECB** assessed the exposures of financial institutions against the 40 firms with the highest carbon emissions. This is an example of an analysis on the basis of single-name exposures and the carbon intensity of their activities when data availability is "medium". The ECB concludes that exposures to transition risks may be significant for some banks.



As another example, in its joint report with the **European Systemic Risk Board (ESRB)**, (ECB-ESRB, 2023), the authors provide information on the exposure of credits granted to NFCs by financial institutions to counterparts with high emission intensity relative to the structure of the economy, measured by gross value added.



3.4.2 Transition risks resulting from climate change

Supervisors usually assess two key factors of transition risk for financial institutions: (1) the policy sensitivity of the exposure from a geographical or sector perspective and (2) the residual maturity of the exposures.[13] Supervisors have gradually adopted, depending on the availability and granularity of data, approaches increasingly sophisticated to quantify the exposures of financial institutions to climate-related risks.

First, supervisors typically take the carbon intensity of financial institutions portfolios as a proxy to assess the sensitivity of exposures to transition risk. This proxy is used as carbon-intensive activities are more likely to be affected by policy changes. To measure the carbon intensity of an asset portfolio, supervisors rely on information on the composition of the portfolio (balance sheet data) and on the carbon intensity of the different constituents within that portfolio (emissions data). GHG emissions may be reported at three different levels (scope 1, 2 and 3 emissions).[14] Carbon intensity can be measured as economic intensity (emissions per tons of revenue or GDP) or as physical intensity (emissions per unit of output, for example, a ton of steel, a megawatt-hour of electricity). The Weighted Average Carbon Intensity (WACI) measures a portfolio's exposure to carbon emissions relative to the revenue generated by the companies in that portfolio. It is calculated as the weighted average of the carbon intensity of each company in the portfolio, with weights based on portfolio allocation. Two types of approaches can be distinguished depending on supervisors' level of maturity:

- **Sector classifications:** Balance sheet data are often readily available on the sector level. Emissions data can be easily obtained by mapping sectors to a measure of carbon intensity. Such a mapping of sectors is provided by Battiston *et al.* (2017) for example. In this study, the climate policy sensitivity of sectors is chosen based on their greenhouse gas emissions, their role in the supply chain and carbon leakage classification. This approach has been applied, for example, by the **European Insurance and Occupational Pensions Authority** (EIOPA, 2019)[15] as an initial understanding of the exposures of the financial sector to transition risks. However, sector-mapping might obscure differences in climate sensitivity within a sector. The transition risk of an in-sector company with much higher emission intensity than its peers would be relatively underestimated and vice versa.
- **Individual exposures and granular analysis:** Analyses that are more granular can cope with differences between individual exposures within the same sector as well as with supply-chain impacts. Supervisors could also consider second-order effects. For instance, the **EIOPA** emphasises that supervisors should consider indirect losses in insurers' investments due to the devaluation of financial counterparties which have high exposures to climate-sensitive sectors (EIOPA, 2019). To assess the dynamics of sectors, supervisors can also consider the country's decarbonisation pathways where the activities of the financial institutions' counterparties are located (as policy measures may have an impact on the transition of these sectors towards more low-carbon activities). Another granular use of data can be the measuring of policy sensitivity based on physical characteristics of an asset. Supervisors assess the energy efficiency of mortgage portfolios in the light of potentially tightening minimum standards or repricing by markets as responses to CO_2-pricing (De Nederlandsche Bank, 2017; Bank of England, 2018).

Second, the residual maturity of the exposure (short, medium, long term) also matters. The longer an activity is in the portfolio of a financial institution, the greater the likelihood that a transition risk may become material before the exposure terminates. For example, a 15-year loan financing a natural gas power plant is more exposed to the risk of stricter carbon pricing, tighter emissions standards, or accelerated renewable energy deployment than a 2-year working capital loan to the same company. Over a longer horizon, policy, technology, or market shifts are more likely to reduce the borrower's profitability or asset value, increasing the institution's credit risk.

13 The policy sensitivity refers to the extent of the exposure's reaction to changes in the regulatory framework related to the adjustment towards a low carbon economy (which may be sector or country specific).

14 Methodologies other than proxies have also been used by supervisors. For instance, supervisors have also assessed the alignment of financial institutions' portfolios with different decarbonisation pathways or carbon budgets. Based on such an analysis, supervisors can quantify the exposure gap of portfolios with respect to the target. See, for example California Department of Insurance (2018) 2° Scenario analysis. Insurance Companies Operating in California.

15 EIOPA assessed the exposure of the insurance sector to climate-related sectors based on the (Battiston *et al.*, 2017) methodology while using Solvency II item-by-item investment data reported by European insurers as of Q1 2018.

The assessment of transition risks varies depending on the type of financial institution. For banks, borrowers can be classified according to their main economic activity. Insurance companies, investment and pension funds, however, can classify the main economic activity of the investees in their asset portfolio. For insurance companies, supervisors often perform a look-through analysis of structured funds investing into multi-layered products. Transition risks within investment portfolios can be measured by considering the ratio between investments highly exposed to transition risk and total investments. This is the approach adopted by the **EIOPA** in its Risk Dashboard for the EU insurance sector.

More advanced emerging practices include the use of portfolio alignment assessments as a complementary tool to evaluate financial institutions' exposure to transition risks. Alignment assessments provide a forward-looking measure of how banks' financing activities compare with specified decarbonisation pathways in key sectors and may provide insights into potential transition risk exposures. However, alignment metrics should be considered alongside broader risk assessments in prudential supervision. Portfolio alignment assessments can complement climate scenario analysis and support integration of climate considerations into firms' risk management frameworks. In particular, portfolio alignment metrics can help translate long-term transition pathways into institution-specific assessments, providing insights that may inform risk monitoring, strategic planning and supervisory dialogue. The practical use of such assessments may be strengthened where financial institutions have developed transition plans, whether on a voluntary basis or pursuant to regulatory or prudential guidance.

Alignment analysis can support supervisory monitoring of elevated credit, strategic, reputational, and litigation risks, and inform supervisory dialogue. This can provide an additional reference point for supervisors in assessing a financial institution's internal assessments of counterparties' transition risks and support supervisory discussions on risk management practices and client engagement strategies. These insights may help supervisors identify potential vulnerabilities associated with the transition to a low-carbon economy and assess their implications for credit, strategic, reputational and litigation risk. As data availability improves and methodologies evolve, supervisors may expand their alignment assessments to additional sectors (for example, shipping, aviation or real estate) and asset classes, further strengthening the supervisory toolkit for identifying exposures that are vulnerable to transition risks.

The NGFS survey indicates a limited number of respondents (13%) has used transition alignment analyses to quantify exposure of financial institutions to climate-related risks.[16] The **ECB** provides an example of a more sophisticated application of alignment analysis for supervisory purposes, having developed internal analytical tools to monitor the alignment of banks' financing with EU climate objectives. The ECB report on *Risks from misalignment of banks' financing with the EU climate objectives* (ECB, 2024c) outlines the assessment approach, which builds on the Paris Agreement Capital Transition Assessment (PACTA) framework. PACTA is an open-source methodology that links banks' credit exposures to the physical production assets of corporations in key transition sectors, covering oil and gas, coal mining, power generation, automotive, steel and cement. The ECB methodology combines credit data with external asset-level datasets and compares corporates' projected production plans – typically over a five-year horizon – with sectoral decarbonisation pathways derived from climate scenarios such as the International Energy Agency's Net Zero Emissions by 2050 scenario. Alignment is assessed at the technology level by distinguishing between technologies that must be phased out, technologies that must be scaled up (such as renewable energy), and sectors where emissions intensity needs to decline. Deviations between projected production changes and pathway-consistent trajectories are aggregated using exposure-weighted metrics across technologies, sectors and exposures to derive portfolio-level alignment indicators. The metrics can provide insight into whether the corporations financed by banks are phasing out carbon-intensive technologies sufficiently quickly, deploying low-carbon technologies at the pace required by transition pathways, or lagging policy-consistent transition trajectories. Such metrics can also help identify exposures that may warrant further assessment from a credit, strategic, reputational and litigation risk perspective.

16 The number of respondents is 9: 2 from Africa, 2 from Asia and Oceania, and 5 from Europe.

Based on these exercises, supervisors have also defined Key Risk Indicators to monitor the development of climate transition risks on the financial institutions they supervise. For instance:

- the carbon-intensive sectors to which regulated financial institutions are exposed;
- the energy label distribution within the commercial real estate portfolio of a financial institution; and
- the financed emissions and carbon intensity of the financial institutions' portfolios.

Key supervisory approaches with different degrees of sophistication and data granularity are presented in Table 3 and Case study 3.2.

Table 3 **Approaches to assessment of transition risk based on policy sensitivity exposures (carbon emissions)**

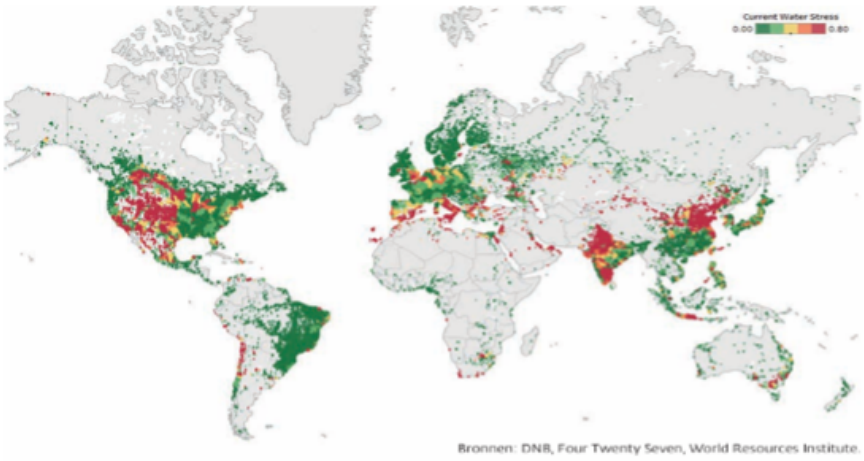
Level of granularity	Approach	Data needs on the balance sheets	Climate-related data needs	Examples
Low	Sector classification	Use internationally recognised classification system (i.e. ISICS, NACE, GICS)	Average carbon intensity per sector	De Nederlandsche Bank, Waterproof? – An exploration of climate-related risks for the Dutch financial sector, 2017, p. 35. De Nederlandsche Bank, Towards more sustainable lending, 2022. Autorité de Contrôle Prudentiel et de Résolution, French banking groups facing climate change-related risks, 2019, chart 8. South African Reserve Bank, Climate-related transition risks in Southern African banks, 2025. Banco Central do Brasil, Financial Stability Report, 2022, section 2. Banco de Mexico, Financial Stability Report, 2025, section IV.4. FINMA, Risikomonitor, 2025.
Medium	Asset-level and/or Firm-level data	Single-name exposures	Carbon emissions data from individual firms EPC label of real estate	ECB, Climate change and financial stability, 2019. ECB and ESRB, Towards macro-prudential frameworks for managing climate risk, 2023. Bundesbank, German residential real estate valuation under NGFS climate scenarios, 2021.
High	Activity-level	Revenue streams from single-name exposures	Production capacity in climate-relevant sectors	EIOPA, sensitivity analysis, 2020.
High	Value-chain	Sector exposures	Input-output tables (embedded emissions)	De Nederlandsche Bank, An energy transition risk stress test for the financial system of the Netherlands, 2018.[1]

1 In the De Nederlandsche Bank report, only the upstream part of the value chain is considered.

Case study 3.3: Example of exposure analysis to physical risks

De Nederlandsche Bank (2019) performed an assessment of the exposures of Dutch financial institutions to extreme water stress regions globally. To that end, De Nederlandsche Bank established for the global 2,000 largest businesses the level of water stress on the geographical locations of their 900,000 business facilities, using a Moody's dataset. This is an example of an assessment based on facility-level data using water stress as a vulnerability indicator to physical climate impacts. De Nederlandsche Bank concludes that water stress poses a risk as roughly 20% of the financial sectors' exposures are located in extremely water stressed regions.

Facilities of listed businesses in the equity portfolios of Dutch financial institutions*

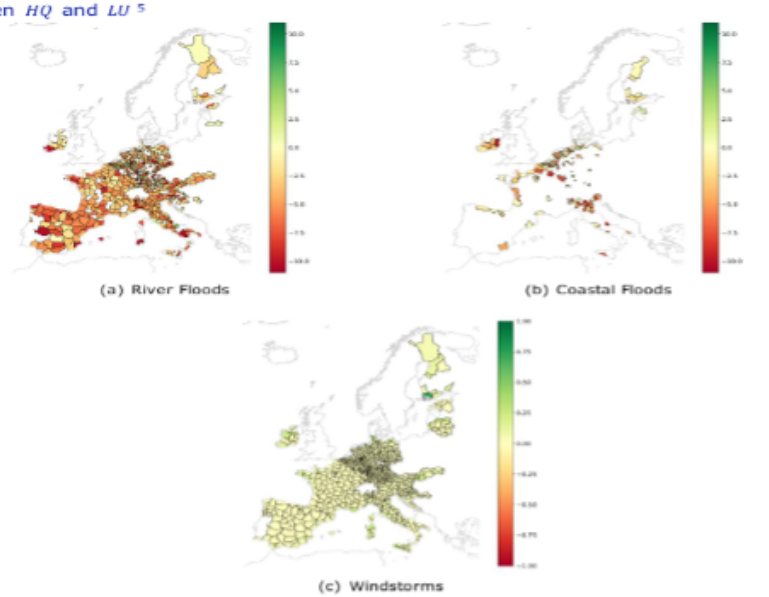


Bronnen: DNB, Four Twenty Seven, World Resources Institute.

* The colours of the dots indicate the water stress level for the facility, ranging from green, signifying low water stress, to red, signifying extremely high water stress.

In 2025, De Nederlandsche Bank assessed the exposure of euro area companies to climate-related physical risks by incorporating the geographic distribution of their production facilities (De Nederlandsche Bank, 2025). It estimated expected annual losses (EAL) from floods and windstorms across NUTS 3 regions. It highlighted areas where relying solely on headquarter locations leads to substantial underestimation of risk.

Euro area maps on NUTS 3 region level of differences in *EAL* estimates between *HQ* and *LU* [5]



3.4.3 Nature-related risks

Some supervisors have begun assessing nature-related risks. In the 2026 NGFS survey, 17 respondents (26%) report some form of nature risk exposure analysis. They rely on a range of data to evaluate the degree to which financial institutions are exposed to the degradation of ecosystems and biodiversity. Supervisors are progressively moving from broad ecosystem dependency screening toward geospatial integration of exposure data, structured sensitivity assessments using portfolio metrics, development of risk-driver-specific indicators and finally, quantitative scenario-based approaches.

Beyond qualitative analysis, supervisors adopt risk driver-level indicators, such as on water availability and quality, land-use pressures, ecosystem degradation, and, where relevant, more specific indicators such as pollination dependencies. This allows for the identification of institutions or sectors most sensitive to specific nature risk drivers, and for a more micro-level mapping of how individual borrowers may transmit environmental risks to bank balance sheets. The choice of nature risk driver is often based on risk sensitivities identified by supervisors in their sensitivity analyses. The French supervisory authority, **Autorité de Contrôle Prudentiel et de Résolution**, for instance, has developed corporate-level indicators capturing dependencies on water availability and exposure to water pollution, linking these metrics to banks' balance sheet to estimate their exposures. **De Nederlandsche Bank** has also estimated financial institutions' exposure to several risk drivers, such as exposure to pollination-dependent agricultural production, exposure to nitrogen-emitting activities, and exposure to activities in biodiversity hotspots. The following Box is extracted from the *NGFS Note on the Supervision of Nature-related Financial Risk* published in April 2026 (NGFS, 2026b) to illustrate how nature-related physical risks could be analysed.

Technical box 3

Example of analysing exposure to nature-related physical risks with the ENCORE tool

To support the process of identifying nature-related physical risks, financial institutions could use publicly available methodologies such as the ENCORE tool, which serves as an initial assessment tool to identify how businesses depend on and impact ecosystem services.[1] The ENCORE tool is anchored by a knowledge base featuring two interconnected pathways: one focusing on dependencies and the other on impacts related to ecosystem components. The dependency pathway analyses the reliance of various economic activities on ecosystem services, assigning a materiality rating to each identified link between an economic activity and an ecosystem service. The ENCORE tool provides materiality scores for the dependency of economic activities on ecosystem services, ranging from 0 (no material dependency) to 1 (very high dependency).

EIOPA conducted a nature-related physical risk assessment (EIOPA, 2023a). The study presents initial findings on insurers' exposures to nature-related physical risks through their direct investments in corporate bonds and equity. The methodology employed assesses the dependency of an economic activity (such as agriculture) on a range of ecosystem services and maps this to insurers' investments by NACE sector of economic activity. The research reveals that almost 30% of insurers' investments in corporate bonds and equity are in economic activities with a high direct dependency on at least one ecosystem service. The major vulnerabilities are related to surface and ground water, as well as flood and storm protection.

1 In (FSB, 2024), it is mentioned that while the ENCORE tool serves as the main dataset used by most of the financial authorities' initial work, it does not differentiate between jurisdictions, which has been noted as a critical limitation.

A few supervisors have started to define Key Risk Indicators to monitor the development of nature-related risks. Examples include:

- the dependency of financial institutions' financing to ecosystem services;
- the biodiversity footprint, and sensitivity of financial institutions to transition policies aiming at protecting or restoring biodiversity;
- the exposure of financial institutions' balance sheet to dependency on water availability, and to water pollution; and
- the exposures to business activities located in currently protected areas.

Supervisors are also developing forward-looking quantitative frameworks to assess nature-related risks. For instance, the **ECB** and **De Nederlandsche Bank** have developed quantitative forward-looking frameworks to assess financial risks arising from ecosystem degradation and natural capital loss in the euro area economy. The ECB, together with the University of Oxford and the London School of Economics, has created the Nature Value at Risk (NVAR), which estimates the share of economic output potentially at risk due to biophysical shocks affecting the availability or quality of ecosystem services. In its Ecosystem Service Degradation Sensitivity Indicator (EDSI), De Nederlandsche Bank integrated dependence on ecosystem services, and the degree of nature degradation, in estimations of credit risk-related losses for banks. Both methodologies are based on three elements: an environmental shock (or hazard), firms' exposure to that shock, and the vulnerability to the shock. While the ECB mirrors financial Value at Risk (VaR), the EDSI uses a traditional risk assessment model used by financial institutions (Merton model) to estimate the absolute impact on banks' capital ratio of nature degradation events.

Finally, some authorities refine the spatial determinants of their risk analysis by combining quantitative and qualitative tools. For example, the **Banco Central do Brasil** merges ENCORE-based dependency metrics with municipality-level obligor location data. This approach complements its monthly environmental risk monitoring framework, which also draws on IFC sectoral methodologies and borrower specific indicators such as environmental fines or mining dam risks (Case study 3.4).

Case study 3.4: Risk analysis by combining quantitative and qualitative tools

The **Banco Central do Brasil** has been progressively incorporating nature-related risk into its prudential framework. It has brought a new assessment methodology that integrates two complementary dimensions: a sectoral risk profile based on the ENCORE framework, covering both impact and dependency channels; and a territorial qualifier based on municipal-level environmental integrity indicators.

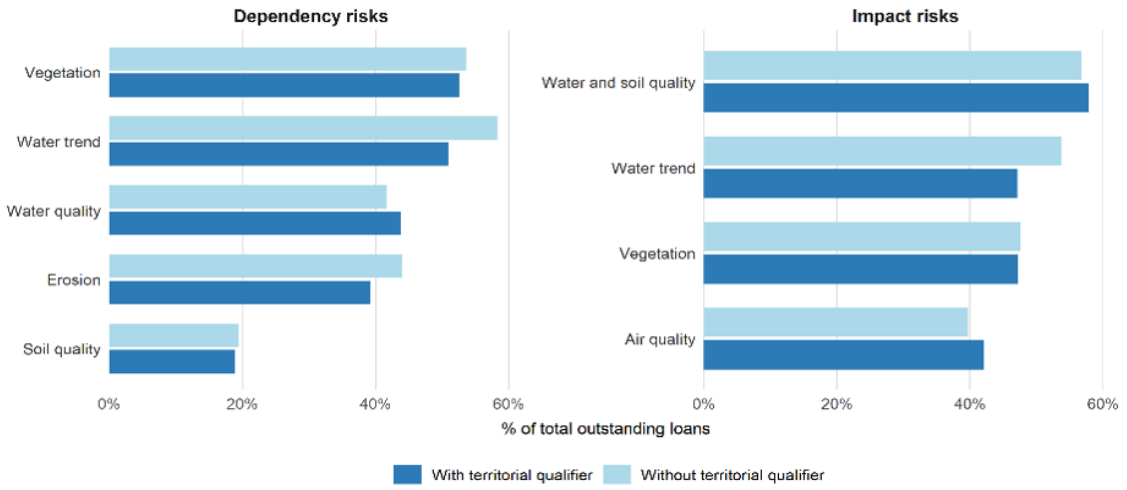
In the first layer, each credit exposure is assigned a sectoral risk score using ENCORE's qualitative ratings of impact and dependency, converted into numerical factors and applied to outstanding loan balances. In the second layer, municipal-level indicators of environmental integrity – covering water availability and trends, ecosystem integrity, soil quality, erosion risk, and air quality, sourced from MapBiomas, EMBRAPA (Brazilian Agricultural Research Corporation), ANA (National Water and Sanitation Agency), and INPE (National Institute of Space Research) – serve as territorial multipliers.[1] Municipalities in better condition receive factors below 1 (attenuating exposure); those in more degraded condition receive factors above 1 (amplifying it). Geolocation of exposures uses credit registry addresses, refined with specific energy-sector data and employer-level data to improve territorial accuracy.

Exposures by risk category

The figure after shows national financial system-wide exposures for each risk category as a share of the total active portfolio. Exposures are high across virtually all categories. For impact risks, water trend and water and soil quality lead to 54% and 57%, respectively. For dependency risk, vegetation and water trend lead, both exceeding 50%. …/…

1 MapBiomas is an initiative of the Climate Observatory and a collaborative network of non-governmental organizations, universities and companies in Brazil, organized with the objective of using quality and low-cost technology to produce annual series of maps (from 1985 onwards).

Figure 1 **Brazilian financial system exposures by risk category (% of outstanding loans)**
Reference: June 2026



Sources: SCR, SICOR, ENCORE, MapBiomas, Embrapa, ANA and INPE.

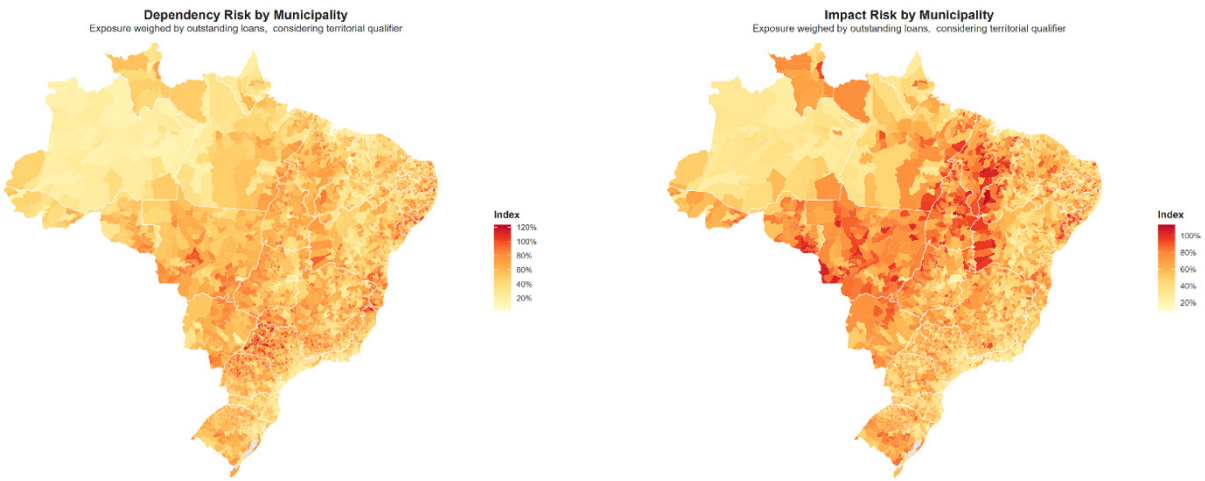
Sectoral concentration

Agriculture, Livestock and Forestry alone account for roughly 25% of the active portfolio in both risk dimensions – more than three times the next sector, industrials. This reflects the sector's dual materiality: it is simultaneously the most dependent on ecosystem services and the most impactful on those same natural components. Manufacturing, Retail and Trade, follow at around 5% and 4%, respectively.

Geographic distribution

The two figures below map dependency and impact risk exposures across Brazil's 5,570 municipalities (as a share of each municipality's outstanding loans) in June 2025. Both maps follow a broadly similar geographic pattern, with higher exposures concentrated in the Center-West and parts of the North – regions corresponding to the active agricultural frontier and areas of greatest pressure on the Cerrado and Amazon biomes. Transition risk exhibits sharper contrast, with markedly higher intensities in these hotspots, reflecting the compounding effect of concentrated environmental impact in territories where ecosystem integrity indicators show the steepest declines.

Figure 2 **Dependence and Impact risk by municipality – risk exposure weighed by outstanding loans and adjusted by local environmental qualifier**
Reference: June 2026



Sources: SCR, SICOR, ENCORE, MapBiomas, Embrapa, ANA and INPE.

Table 4 **Approaches to assess nature-related risks**

Level of granularity	Approach	Data needs for FIs (balance sheets)	Data needs for FIs (climate-related)	Examples
Low	Sensitivity analysis: dependency on ecosystem services and biodiversity impact	Sectoral and/ or geographical classification systems	Sectoral dependency indicators (e.g., ENCORE scores) and/or impact indicators (e.g., Potentially Disappeared Fraction of species (PDF) or in Mean Species Average (MSA)	De Nederlandsche Bank, Values at risk? Sustainability risks and goals in the Dutch financial sector (2019).
Medium	Portfolio sensitivity analysis	Single-name exposures, their revenue sources and location	Single-name dependency and/or impact indicators	De Nederlandsche Bank, Indebted to nature – Exploring biodiversity risks for the Dutch financial sector (2020). ECB, The impact of the euro area economy and banks on biodiversity (2023). Banco Central do Brasil, Financial Stability Report, 2022, section 2.2. Bank Negara Malaysia, An Exploration of Nature-related Financial Risks in Malaysia (2022). OECD – Bank Negara Malaysia, The joint biodiversity project of MNB and OECD with the support of the European Commission (2024). Banque de France, A "Silent Spring" for the Financial System? Exploring Biodiversity-Related Financial Risks in France (2021).
High	Analysis at the environmental risk driver level	Single name exposures, their revenue sources and location	Impact or dependency indicator at the environmental risk driver level, for example, water consumption, pollution, dependency on pollination	De Nederlandsche Bank, What's the damage? Monetizing the environmental externalities of the Dutch economy and its supply chain (2021b).

In a nature-related Compendium of implementation practices to be released before the end of 2026, the NGFS identifies, through case studies and a survey of existing nature framework applications, efficient methods and tools to assess nature-related risks, and particularly material risks that its members could prioritise (NGFS, forthcoming). Such a report could further help supervisors undertake precise, efficient nature-risk assessments.

3.5 Scenario analysis and stress tests

3.5.1 Scenario analysis and stress tests for climate-related risks

Climate scenario analysis and stress tests are becoming a key quantitative tool for financial institutions and supervisors to explore the impact of different possible climate change pathways. Scenario analysis and the associated governance framework support a holistic supervisory assessment of risks and may contribute to all three types of supervisory assessment described in the introduction to this chapter (Section 3.1). They can facilitate a forward-looking assessment of gross climate-related exposures, enhance supervisors' understanding of the institution's risk management framework, and, in more advanced applications, provide an assessment of residual risks that incorporates the effects of adaptation and/or mitigation measures. The BCBS recognises the role of climate scenario analysis in strengthening the management and supervision of climate-related financial risks and has studied its usage-specific considerations by banks and supervisors (BCBS, 2024). A key feature of the scenarios analysed is to explore alternatives that may significantly alter the basis for "business-as-usual" assumptions (BCBS, 2021). Climate scenario analysis enables financial institutions and policymakers to adopt a forward-looking assessment of climate-related risks,

exploring different sources of uncertainty stemming from climate change and transition policies. It encompasses a wide range of methodologies (which can be qualitative and/or quantitative) and use-cases, such as investment decisions, portfolio alignment, risk management and transition planning. Climate stress tests can be seen as a specific application of climate scenario analysis that explicitly use a set of adverse scenarios that are severe tail risks but plausible to test the short-term resilience of financial institutions or portfolios to climate-related shocks. In a stress test, climate risk drivers are translated into economic and financial variables, which are then applied through models to estimate impacts on the balance sheets and capital positions of financial institutions (EBA, 2025).

Technical box 4

Using NGFS long-term and short-term scenarios for supervisory climate risk analysis

The NGFS has developed climate scenarios to offer a global reference framework that supervisors and financial institutions can use, while also ensuring consistency, comparability and transparency across jurisdictions. The NGFS provides two complementary sets of climate scenarios: long-term scenarios, which extend to the end of the century, and short-term scenarios, which focus on a 5-year horizon. Long-term scenarios contextualise structural shifts and trends across different climate pathways. They have become a standard tool in financial risk assessment. Regularly enhanced and updated with the latest economic and climate data, the NGFS has released five vintages of the long-term scenarios so far. On the other hand, short-term scenarios illuminate near-term tail risks triggered by climate drivers and are closer to standard stress test scenarios, offering a wider set of output variables including financial variables at country-sector level.[1] The NGFS has developed and released in May 2025 its first vintage of short-term scenarios.

A 4-step approach to climate scenario analysis

The recently updated NGFS User Guide for Climate Scenarios for central banks and supervisors (NGFS, 2025b) lays out a structured process to conduct climate scenario analysis and elaborates on practical considerations, illustrated by recent use cases.

Step 1 – Identifying objectives and scope of the analysis: A clear definition of the objective is essential as this determines the time horizon and approach of the exercise. An exercise can target, for instance, firm-level resilience, system-wide risks or broader macroeconomic impacts. At the outset, supervisors should conduct a materiality assessment to identify the most relevant climate risk drivers, considering sectoral and geographical exposures as well as key macro-financial transmission channels.

Step 2 – Choice and design of scenarios: The choice of the scenario narratives and time horizon should be guided by the type of risks supervisors aim to explore. The NGFS scenarios provide an initial, common reference framework, but users may need to tailor them by adjusting the level of detail and granularity, or specific policy assumptions, while maintaining internal consistency.

Step 3 – Assessing economic and financial impacts: This step encompasses the translation of scenario narratives and projections into economic or financial impacts, such as changes in profitability, credit losses, or market valuations. Supervisors should carefully consider the transmission channels through which physical and transition risks affect, for example, output, prices, asset values and creditworthiness, as well as the methodological choice between top-down and bottom-up approaches. Sensitivity analysis and robustness checks are important to understand how results depend on key modelling assumptions and data limitations. …/…

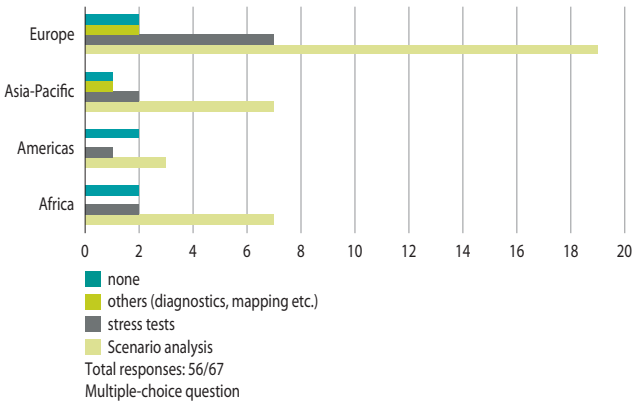
1 The financial variables do not comprise financial losses per se but rather financial risk metrics that can be used to compute losses (e.g., default probabilities, bond spreads, and capital costs).

Step 4 – Communication and use of the results: Effective communication should clearly explain the objectives, assumptions and limitations of the exercise, emphasising that scenarios are exploratory tools rather than forecasts. NGFS scenarios should not remain a stand-alone analytical exercise but rather be integrated into supervisory processes by informing supervisory dialogue, guiding guidance regarding risk assessment and management, and supporting supervisory monitoring. Supervisors can also consider how findings may trigger follow-up analysis, improvements in data collection, or refinements of supervisory frameworks over time.

Scenario analysis does not eliminate uncertainty but helps structure it. By embedding NGFS scenarios into supervisory frameworks, aligned with clear objectives and appropriate scenario design and modelling choices, supervisors can enhance their capacity to identify, compare, and address climate-related uncertainties and risks, and strengthen the resilience of the financial system from a forward-looking perspective.

Supervisory adoption of climate scenario analysis and stress testing has expanded markedly, from limited use in 2020 when the Guide was first published, to 73% of surveyed supervisors by 2026. Most supervisors surveyed (51%) conduct climate scenario analysis or stress tests on both transition risk and physical risk. Supervisors of different regions have a slightly different appetite for transition or physical risk, with those from Africa and Americas focusing more on physical risk while those from Europe paying more attention to transition risk. This can be related to differences in climate change impact, and economic structures across regions. While the use of climate scenario analysis and stress testing has expanded significantly, supervisory practices remain heterogeneous. Scenario exercises range from exploratory, one-off analyses aimed at improving understanding of climate-related risks and building internal capacity, to more advanced and recurring exercises that are integrated into supervisory assessments.

Figure 9 **Methodologies used by supervisors to quantify climate-related risks**



Source: NGFS Survey.

As supervisors gain experience and analytical capabilities strengthen, scenario analysis can progressively evolve from a learning tool into a more established component of the supervisory framework.

Different approaches can be adopted by supervisors when conducting climate scenario analysis. In bottom-up exercises, supervisors provide scenarios and methodological guidance to banks, which then run their own models to quantify the impact on portfolios. In top-down exercises, supervisors instead apply their own models on data collected from banks to quantify the impacts, thereby also ensuring greater comparability across the banking system. Moreover, balance sheet assumptions could be static or dynamic, in which the former implies that exposures are kept constant throughout the exercise, and the latter allowing for management actions and strategic adjustments over time. The time horizon also varies depending on the objective of the exercise. Short-term scenarios (3-5 years) are commonly used to test resilience to acute shocks, such as extreme weather or sudden policy changes. Long-term scenarios (up to 30 years) are used to evaluate the effect of structural economic shifts. Supervisors may also distinguish between short-term stress testing aimed at assessing financial resilience to adverse shocks, and longer-term resilience analysis aimed at assessing the robustness of institutions' business models and strategies under a range of plausible transition and physical risk pathways.

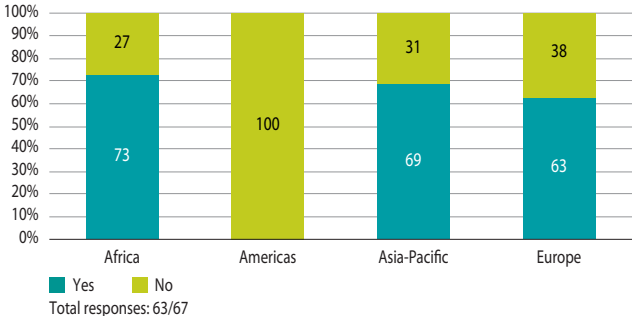
For most supervisors, climate scenario analysis and stress test work is being developed for policy and analytical purposes as well as for direct supervisory application. They consider that these tools can help identify which specific exposures or asset classes are vulnerable

to physical and transition risk drivers. This enables them to quantify concentrated exposures and potential losses, thus improving the overall identification of risks that could materially impair the financial condition of supervised financial institutions. Some supervisors plan to make use of climate stress test results for supervisory purposes (for example, with potential capital consequences) in the short to medium terms, and some consider using climate scenario analysis to inform transition plan assessments. Figure 7 and Case study 3.5 below present respectively the numbers (in percentage and absolute value) of institutions that have conducted a climate stress test exercise for supervision purposes and practical cases.

Two methodologies are commonly used: macro approach and micro-macro approach. Macro approaches assess the impact on financial portfolios by using high-level proxies for risk, while micro approaches assess the potential impact from climate variables on counterparties from a granular level. For example, a macro model can be downscaled to sectoral level using climate risk variables (such as the level of emissions) as a proxy for risk. Similarly, a micro-level assessment can be complemented with macro scenario variables to capture wider macroeconomic channels. In such cases overlays can be applied to macroeconomic variables. In general, compared with macro approach, more granular damages/exposures data are needed in micro-macro approach. Once the macro-financial (and sectoral) linkages are built, the conventional approach for banks' stress testing is applied to assess the physical/transition risks and the impact on bank capital. While some supervisors (29%) choose to use micro-macro approaches and some (12%) prefer macro approach, an increasing number of supervisors (20%) use both approaches in their analyses, using one approach on transition risk and another one on physical risk.

- For transition risk, the macro approach starts by mapping climate scenarios (carbon-related shocks) into macro and sectoral models and then uses the output variables (macroeconomic ones) to assess how the bank's balance sheet will be impacted.
- The micro-macro approach links macroeconomic variables under different scenarios with corporates' balance sheet items (micro-level indicators) to see how these corporates' balance sheet will evolve and their credit risk profiles will change. These corporate-level output are then used to assess the impact on banks' capital. For instance, the Bangko Sentral ng Pilipinas used macro approach by linking the NPL ratio with output at the sectoral level to assess the impact of transition risk in the Philippine banking system (World Bank Group and Bangko Sentral ng Pilipinas, 2024). The International Monetary Fund (IMF) conducted transition risk analysis of Indonesia followed an integrated micro-macro approach where transition scenarios for various economic sectors are structurally linked to corporate vulnerability indicators and then translated into corporate credit risk paths and eventually banks' credit exposures (IMF, 2025). For physical risk, the macro approach incorporates analysis of capital and productivity shocks due to hazard damages on macroeconomic and financial variables using macro models. Damages are aggregated at country-level and used as an input in macro models to generate macro financial scenarios due to climate shocks.
- The micro-macro approach starts the analysis at individual firms and households to estimate the impact of physical risk on their balance sheets and integrates with the macro models. For instance, the IMF examined the impact of the aggregate flood damages on Dutch banking sector at the country level (IMF, 2024) while the DNB connected the Dutch flood maps with the data on the location of banks' real-estate exposures and computed the property damage under different scenarios using damage functions (De Nederlandsche Bank, 2021).

Figure 10 **Supervisors surveyed that have conducted a climate stress test for supervisory purposes**



Source: NGFS Survey.

Case study 3.5: Stress test exercises	
Australia	The **Australian Prudential Regulation Authority**'s (APRA) Climate Vulnerability Assessments (CVA) provide examples of a supervisor using NGFS-based scenarios to assess climate-related financial risks across the banking and insurance sectors. APRA's first CVA assessed the physical and transition-risk implications for Australia's five largest banks, while the second CVA assessed how home insurance affordability and the insurance protection gap may evolve under future climate scenarios (APRA, 2022 and 2026). Together, these stress tests highlight how climate-related risks and widening protection gaps can transmit across households, insurers, banks and governments, and can inform supervisory and policy engagement on adaptation, risk reduction and financial resilience.
Brazil	The **Banco Central do Brasil** has developed the use of scenario-based analyses to assess the potential impact of climate-related risks – particularly transition risks – on financial institutions' balance sheets and credit portfolios. In practice, Banco Central do Brasil has explored the application of climate stress testing methodologies focusing on sectoral exposures that are more sensitive to transition dynamics, such as carbon-intensive industries. These exercises typically rely on forward-looking scenarios and aim to capture the potential effects of policy changes, shifts in market preferences, and technological developments associated with the transition to a low-carbon economy. The results of these analyses contribute to enhancing supervisory understanding of vulnerabilities within the financial system, while also supporting dialogue with supervised institutions regarding risk identification and management practices. More broadly, the Brazilian approach illustrates how scenario-based analyses can be embedded within an evolving supervisory framework, complementing other tools such as disclosure requirements and risk management guidance. While methodologies and data availability continue to evolve, the use of climate stress testing by the Banco Central do Brasil provides a practical example of how supervisory authorities can develop forward-looking analytical capabilities to better assess climate-related risks.
Egypt	The **Central Bank of Egypt** integrates climate change risks into its macro-prudential risk assessment primarily through scenario-based stress testing exercises. Within the supervisory framework, climate change is explicitly treated as a source of systemic risk, and forward-looking stress test scenarios are designed to assess the potential impact of climate-related shocks on the solvency and liquidity of financial institutions. Climate stress testing scenarios incorporate transition and physical risk channels and are conducted with graded levels of severity. The exercises evaluate the exposure of the banking sector to climate-sensitive economic sectors and the transmission of climate-related shocks across the financial system. In particular, the framework provides evidence on the sectors most vulnerable to physical risks and assesses the potential impact on the real economy, while also identifying sectors most exposed to transition risks arising from policy, technological and market adjustments associated with the low-carbon transition. Consistent with this sectoral analysis, the stress testing exercise places a specific focus on banking risks resulting from both physical and transition risks, examining how climate-related shocks may materialize through credit, market and liquidity risk channels and affect banks' balance sheets and resilience. These outcomes enhance supervisory understanding of climate-related risks and support ongoing engagement with supervised entities on risk identification, governance, and the integration of climate considerations into risk management frameworks.

…/…

European Union	In 2022, the **ECB** carried out a climate risk stress test to assess how well banks operating in the European Union are prepared to manage climate-related risks under two different scenarios that assessed physical risks, as well as short and long-term risks stemming from the transition to a greener economy. Under the three short-term scenarios (a three-year disorderly transition and two physical risk scenarios), banks reported a total of €70 billion in losses. However, those figures could be significantly undervalued due to methodological constraints and data gaps. While banks were able to provide meaningful input to the exercise, they face significant challenges in terms of modelling techniques and data availability. This exercise nonetheless helped banks strengthen their climate stress testing capabilities and the results fed into ECB's Supervisory Review and Evaluation Process from a qualitative point of view. All participating banks also received individual feedback. In March 2023, the European Commission issued a letter inviting EU supervisory authorities, the ECB, and the ESRB to conduct a one-off "Fit for 55" climate risk scenario analysis to evaluate the financial sector's resilience in line with EU regulatory objectives. This exercise enables EU authorities to obtain both sector-specific first-round loss estimates and a cross-sectoral view of some second-round effects, covering a large part of the EU financial system.
Hong Kong	The **Hong Kong Monetary Authority** conducted two rounds of Climate Risk Stress Test exercises to assess the potential impact of climate change on the Hong Kong banking sector and facilitate capability building. In both exercises, the findings confirmed that the sector demonstrated strong resilience, supported by strong capital buffers well above international minimum requirements. The first pilot exercise, launched in 2021, assessed the potential impact of climate change on the Hong Kong banking sector. A total of 27 banks, representing 80% of the sector's total lending, participated in the exercise which examined three climate scenarios (orderly transition, disorderly transition and physical risk scenarios). This exercise enabled the Hong Kong Monetary Authority to evaluate the impact of climate change on its banking sector, highlighting that such risks can materially affect banks' profitability, capital positions and operations. A second Climate Risk Stress Test was conducted in 2023-2024, involving 46 banks, and representing 91% of the sector's total lending. The exercise assessed banks' exposures under a short-term scenario (2023-2027) and three long-term scenarios derived from the NGFS scenarios, reflecting different transition pathways (2023-2050). The results also suggest that an orderly transition would be relatively favourable for the sector in the long run. Compared to the first pilot exercise, the Hong Kong Monetary Authority noted that banks have strengthened their stress-testing capabilities, particularly in areas such as model governance, data collection and methodologies. Following these two rounds of sector-wide exercise, the Hong Kong Monetary Authority would optimize the integration of climate-related risks into its regular supervisor-driven stress testing framework.

…/…

Morocco

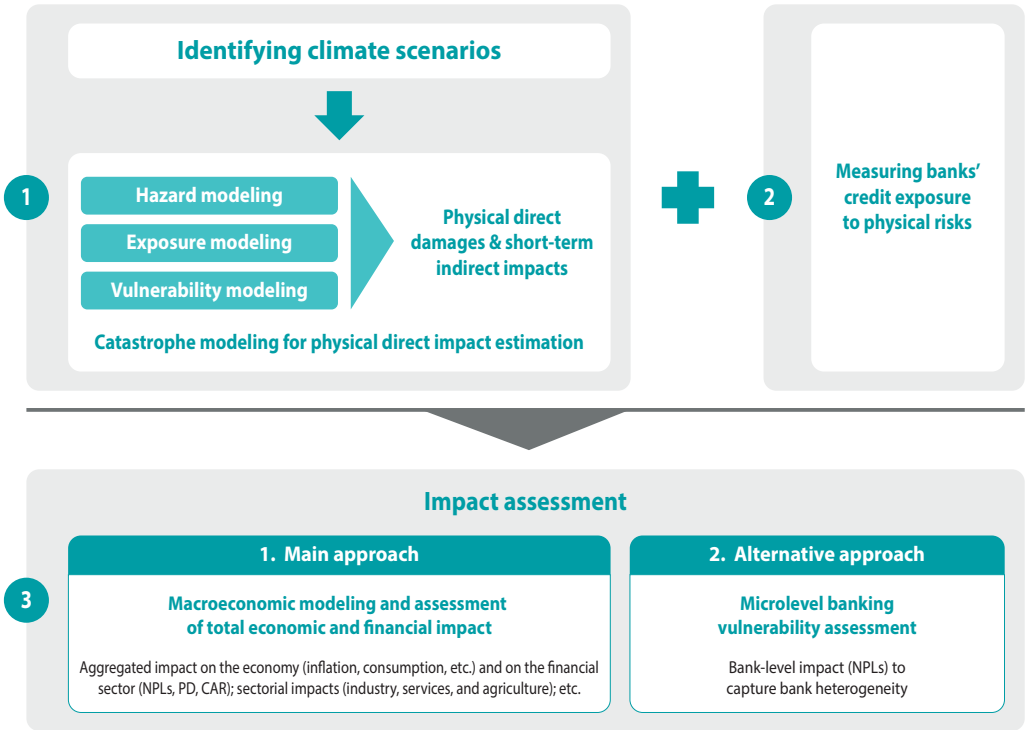
Bank Al-Maghrib and the World Bank assessed climate physical and transition risks for Moroccan banking sector, by using a micro-macro analysis and a complementary micro analysis. They published the results of their analyses in the report "Double Trouble" (World Bank Group, 2024b).

Quantifying Physical Risks

Bank Al-Maghrib developed extreme event scenarios for the two physical perils most material for Morocco – droughts and floods. Five climate scenarios were used for each peril: current climate (historical), 2030/2050 under RCP 4.5 and RCP 8.5. The Bank Al-Maghrib first estimated the direct damages and short-term indirect impacts of these scenarios under different Return Periods. To do so, it combined three modules: (i) a hazard module on the occurrence, intensity and duration of the event; (ii) an exposure module on assets and (iii) a vulnerability module on damages. The report provides results on banks' credit exposure by region and sector. Additionally, Bank Al-Maghrib modelled the macroeconomic (GDP, unemployment, public deficit) and financial (NPL, PD and CAR) impacts of the scenarios at an aggregated and sector-specific level using a macro financial model.

This macro approach is completed by an alternative vulnerability assessment at micro level. The impacts from the catastrophe modelling are directly applied to loan portfolios and aggregated at the bank level. Finally, standard balance sheet stress test methodologies are used to link the NPL shock with the impact on CAR. The analysis suggests that climate change exacerbates the impact of droughts and floods on macroeconomic and financial sector indicators. But the impact of floods is significantly lower compared to the drought scenarios. …/…

Overview of the approach for assessing climate physical risks for the financial sector



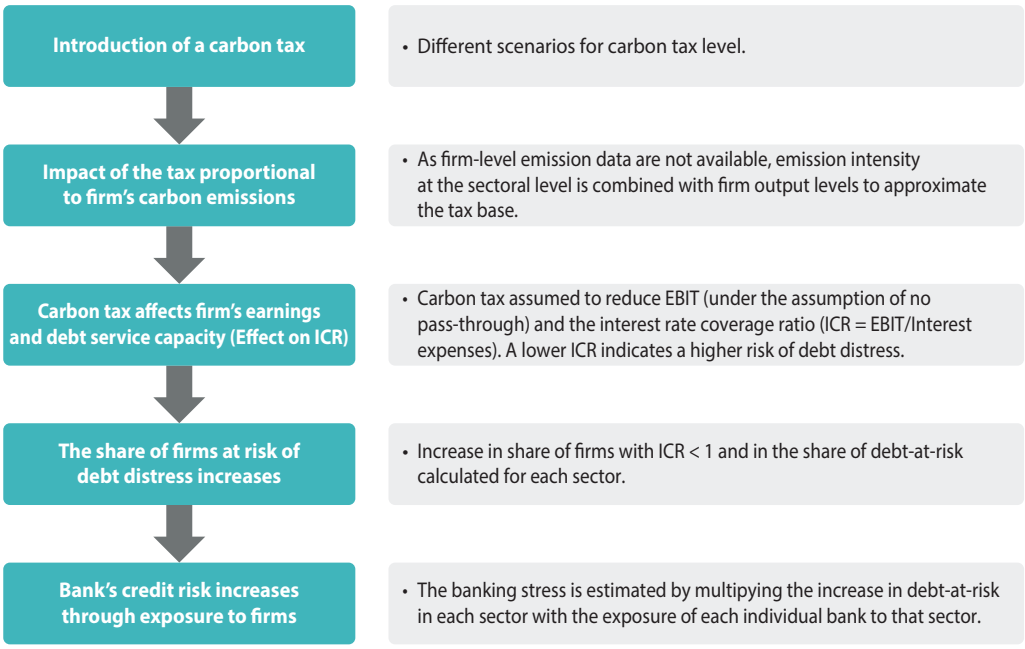
Morocco

Quantifying Transition Risks

Transition risk was assessed by modelling the impact of an abrupt introduction of a carbon price on firms' financial health. Two carbon tax scenarios were used: \$25/tCO_2 and \$75/tCO_2; and an alternative scenario to assess the impact of the EU's Carbon Border Adjustment Mechanism (CBAM) by applying a carbon price of \$150/tCO_2 in sectors targeted by CBAM.

To estimate the impact of higher carbon prices on nonfinancial firms, Bank Al-Maghrib used the interest rate coverage ratio (ICR) to measure a firm's debt serving capacity and assumed that higher carbon prices directly reduce a firm's earnings proportional to its level of emissions.[1] Because firm level emissions data were unavailable, Bank Al-Maghrib used sectoral proxies on emissions per unit of output. Additionally, in the absence of information on bank-firm specific exposures, Bank Al-Maghrib followed the methodology outlined by the IMF (IMF, 2021). It aggregated the deterioration of firms' financial health at the sectoral level and linked it with bank-level sectoral exposures. Results were expressed as the share of total and non-financial corporate loans sensitive to transition shocks, with detailed exposure per sector.

Methodology for assessing transition risks for the banking sector



Supervisory use and next steps

In light of these results, Bank Al-Maghrib, which was already working on banks' climate-related risk management and on the integration of climate-related risks into its supervisory review process (SRP), assessed whether its macro and micro-prudential monitoring and assessment framework needed to be structurally updated to embed identified climate-related risks. The report issues recommendations, notably applicable to the Bank, such as:

- Collecting data and setting indicators required to build institutional capacity,
- Consider thematic supervisory reviews or on-site supervision for highly exposed entities,
- Develop more supervisory guidance for the banking sector to enhance the management of climate-related risks.

1 If the ICR is below 1, a firm does not generate sufficient earnings to cover its interest expenditures and is thus classified as in risk of debt distress.

3.5.2 Scenario analyses and stress test exercises for nature-related risks

Supervisors have also started to work on the development of nature-related scenarios, notably in the NGFS context, and a few of them have conducted the first nature-related stress tests. The NGFS technical document *Recommendations towards the development of scenarios for assessing nature-related economic and financial risks* (NGFS, 2023d) provides concrete recommendations regarding how supervisors can move from static analysis towards consistent scenarios through which nature-related risks can be better understood and assessed. It proposes approaches to developing narratives and reviews a range of modelling approaches for scenarios of two main types (nature-economy models and biophysical models).

Technical box 5

Development of nature scenarios – recent advances in the development of nature-related risk scenarios

Nature scenarios are forward-looking tools that help supervisors, central banks, and financial institutions understand the financial consequences of nature degradation – such as biodiversity loss, water scarcity, or deforestation. Because climate change and nature loss are deeply interlinked, the NGFS' ultimate objective is to design scenarios that capture both risks simultaneously to capture the critical interactions between these risks. Recent work by the NGFS on the improvement of modelling tools for nature-related financial risks scenarios (NGFS, 2026d) highlights the following points:

Noteworthy advances are emerging

- **From exposure mapping to quantitative risk frameworks:** Tools such as ENCORE national and global input-output databases (EXIOBASE, GLORIA) enable systematic identification of nature-dependent sectors. Building on this, NGFS members have developed pioneering quantitative approaches.[1]
- **Integrated modelling and first stress tests:** Emerging frameworks connect biophysical models with macro-financial models, enabling a more comprehensive analysis of risk transmission channels (World Bank Group, 2021). Some studies have already conducted first nature-related stress tests on bank portfolios, demonstrating a viable pathway toward scenario-based supervisory oversight (Green Finance Institute, 2024).

Key challenges remain

- **Complexity and data gaps:** Nature-related risks require multiple metrics, as natural processes related to biodiversity, water, soil, and land use each demand distinct analyses. Likewise, nature loss can materialize through local phenomena linked to global processes, and across interconnected ecosystems where degradation in one cascades to others. Furthermore, granular, location-specific data on firm assets and ecosystem conditions remain frequently missing.
- **Incomplete biophysical-economic linkages:** Ecosystem services are rarely modelled as explicit inputs to production functions. As a result, the transmission channels through which nature degradation – or the costs of transitioning away from nature-harming activities – translate into economic and financial outcomes such as output loss, defaults, and inflation remain underdeveloped in most existing frameworks.
- **Modelling challenges:** Most current macroeconomic models struggle to represent tipping points, irreversible thresholds, limited substitutability of ecosystem services, and non-linear feedback. Ignoring these features, which are pervasive in ecosystem dynamics, may lead to a significant underestimation of macroeconomic and financial risks.

.../...

1 De Nederlandsche Bank's EDSI links ecosystem shocks to bank capital adequacy (De Nederlandsche Bank, 2024); the ECB's risk-based assessment applying the nature value at-risk (NVaR) framework (ECB, 2025a); and Banque de France analysis estimates nature-related agricultural shocks could raise inflation by 0.4-0.5 percentage points (Banque de France, 2025).

Designing nature scenarios and the way forward

- **Key design considerations:** Scenario design requires balancing severity with plausibility, matching the analytical perspective to the intended use (macro versus micro), and managing the trade-off between local granularity and global consistency. Further considerations could also include selecting appropriate time horizons and preserving the specificity of nature-related risks when developing fully integrated climate-nature scenarios.
- **Priorities for the way forward:** Building on and further refining pioneering tools already developed by NGFS members, key priorities include: fostering multidisciplinary co-development of analytical capacity both within supervisory authorities and across the research community; improving data quality and geospatial granularity through well-funded, continuously updated data collection and data flows; and ensuring credibility through transparent uncertainty frameworks, diverse parallel modelling, and open-source model documentation.

Some supervisors have already conducted stress test on nature-related risks. Notably, the Bangko Sentral ng Pilipinas conducted a stylised bottomup credit stress test in 2023 to assess the solvency impact of biodiversity loss. Bangko Sentral ng Pilipinas' methodology generally followed the IMF's climatestresstesting principles but adapted them to the specificities of biodiversity risk and a oneyear time horizon (Case study 3.6).

Case study 3.6: Stress test on biodiversity risks from Bangko Sentral ng Pilipinas

Bangko Sentral ng Pilipinas (BSP) conducted a stylized credit stress test to gauge solvency impacts of biodiversity risks (Bangko Sentral ng Pilipinas, 2023). Philippines' economy depends on natural capital, especially through agriculture, forestry and fisheries sectors, which provides essential intermediate inputs to most industries and accounts for a significant share of employment and output. Shocks to biodiversity may propagate widely across the economy and financial system, via credit, market, operational and liquidity channels, with physical, transition and reputational risks acting as key mechanisms. Major pressures identified include deforestation, habitat destruction, overexploitation of natural resources, land-use conflicts, population pressures, invasive species and climate change. Spatial analysis using global biodiversity depletion data shows that many Philippine regions fall into medium or high depletion categories, with some hotspot areas overlapping commercial land uses such as cropland and plantations.

Bangko Sentral ng Pilipinas constructed indicators along three dimensions:

- Sectoral exposure to biodiversity-dependent activities, particularly sectors relying heavily on ecosystem services such as agriculture and fisheries.
- Geographical exposure to areas with biodiversity depletion or hotspot risk, based on ENCORE-related global datasets.
- Changes in natural capital conditions over time, used to approximate potential deterioration in credit quality associated with biodiversity loss.

Bangko Sentral ng Pilipinas' study presents estimated values of Philippine Biodiversity and Ecosystem Services. Crop production, carbon offset, and Ecotourism represent 90% of the total estimated value of ecosystem services.

…/…

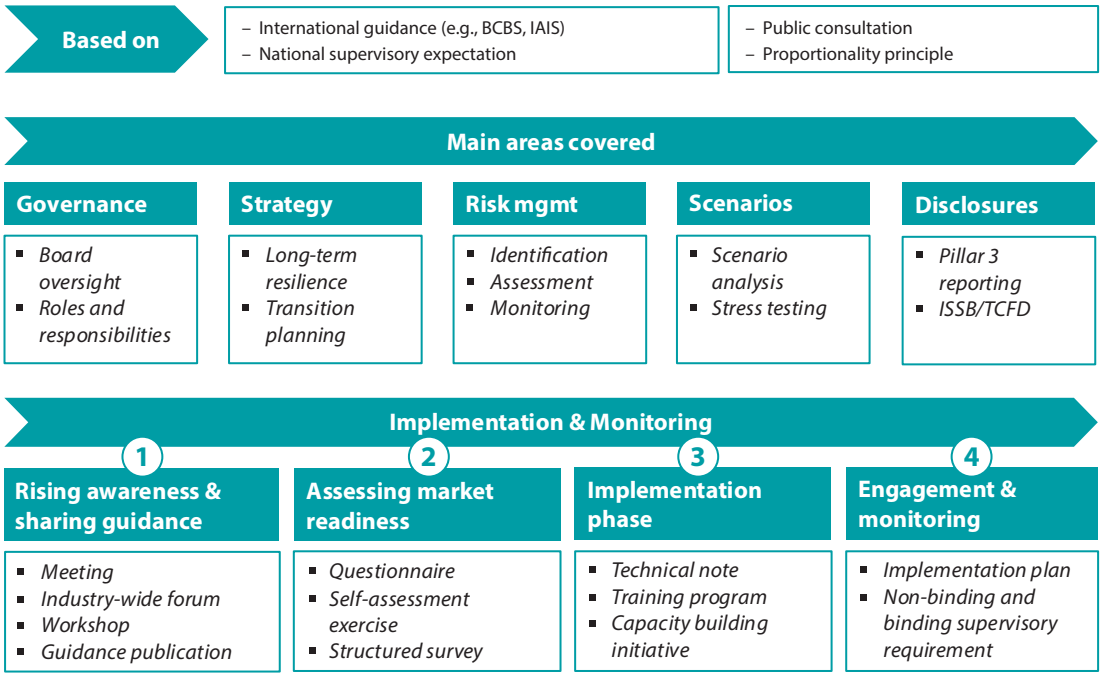
To assess potential financial impacts, the report applies a stylised bank solvency stress-testing framework linking biodiversity loss to credit risk and capital adequacy. The methodology first maps ENCORE's estimated biodiversity depletion data to subnational regions and classifies them into three degrees of severity: medium, high and hotspot biodiversity losses. Regional bank lending data are then combined with these classifications to apply assumed shocks to banks' outstanding loans. The resulting changes in loan exposures are used to evaluate the implications for credit risk and banks' capital adequacy ratios. Other risk channels, such as market risk or systemic feedback effects, are not incorporated due to data and methodological constraints. Results indicate that the initial direct impact of biodiversity loss on the Philippine banking system appears modest. However, the analysis highlights that indirect effects – particularly through supply chains and broader economic interconnections – could be significantly larger than the measured direct impacts. The exercise is therefore intended as an exploratory sensitivity analysis rather than a comprehensive macro-financial stress test.

4. Supervisory guidance for financial institutions

This chapter outlines the main international principles underpinning supervisory guidance regarding climate and nature-related risks and presents the key areas typically covered by guidance, including governance, strategy, risk management, scenario analysis and stress testing, and disclosures. It then examines the process through which supervisory guidance is developed, as well as the different approaches used to support, monitor, and assess their implementation by financial institutions. Finally, the chapter discusses how supervisory guidance may progressively evolve to incorporate nature-related risks and highlights initiatives related to taxonomy development.

Recommendation 4 – Establish, implement, and monitor supervisory expectations, consistent with relevant international guidelines, to provide financial institutions with clarity regarding a prudent approach to managing climate and nature-related risks.

Figure 11 **Phased approach to implement and monitor supervisory guidance for financial institutions**



4.1 International frameworks for financial institutions

Supervisory guidance on climate-related risks is often built upon internationally recognized principles. International principles help establish a common baseline for risk management practices while preserving sufficient flexibility to accommodate differences across jurisdictions, business models, institutional capacities, and the evolving nature of climate risk management. These international principles primarily focus on climate-related risks, including both physical and transition risks. To date, explicit references to nature-related risks remain relatively limited, although growing recognition of the interconnections between climate and nature is driving increasing consideration of nature-related issues within supervisory frameworks (Section 4.5). The guidance developed by international standard setters and supervisory authorities on climate-related and nature-related risks remains, in many cases, flexible and non-binding. To reflect the broad range of

approaches observed across jurisdictions, this chapter refers to guidance and principles, highlighting their generally voluntary nature. Nevertheless, it should be noted that, in some jurisdictions, certain guidance has been incorporated into supervisory or regulatory frameworks and is now subject to formal implementation requirements and timelines.

For the banking sector, the BCBS has advanced work on climate-related risks through the publication of dedicated principles and the revision of the Basel Core Principles for Effective Banking Supervision (BCPs). In 2022, the BCBS issued its *Principles for the Effective Management and Supervision of Climate-related Financial Risks*, representing the first international supervisory guidelines specifically focused on climate-related risks in the banking sector (BCBS, 2022a). Although the Basel Core Principles were already considered sufficiently broad and flexible to accommodate supervisory responses to emerging risks, including climate-related risks, the dedicated BCBS principles were developed to promote greater consistency in supervisory guidance and risk management practices across jurisdictions. They cover a wide range of areas, including governance, internal controls, risk management processes, capital and liquidity considerations, scenario analysis, and supervisory review. Building on this work, the 2024 revision of the Basel Core Principles for Effective Banking Supervision included explicit references to climate-related risks and strengthened guidance on their supervisory treatment. These revisions further embed climate-related considerations within the core framework for prudential supervision and reinforce the expectation that banks identify, assess, monitor, and manage climate-related risks as part of their overall risk management and governance frameworks.

For the insurance sector, the IAIS has progressively integrated climate-related considerations into its supervisory and supporting material through limited revisions to the Insurance Core Principles (ICPs) and the development of an Application Paper on supervising climate-related risks in the insurance sector (IAIS, 2025a).[17] The paper aims to supplement the ICPs to further support supervisors in their efforts to integrate climate risk considerations into the supervision of the insurance sector. It provides background and guidance on how the IAIS ICPs can be used to manage the challenges and opportunities arising from climate-related risks. Topics and ICPs covered include those relating to corporate governance, risk management and internal controls, valuation, investments, enterprise risk management, scenario analysis, supervisory reporting and disclosures, group-wide supervision, and macro-prudential supervision. In doing so, it provides supervisors with a comprehensive framework for integrating climate-related risks into insurance supervision while promoting greater international consistency in supervisory approaches.

Importantly, the BCBS and IAIS do not treat climate-related risks as a separate risk category. Rather, climate-related risks are viewed as drivers of traditional financial risks and are therefore expected to be integrated into existing risk management and supervisory frameworks.

4.2 Main areas covered in supervisory guidance

Supervisory practices can be grouped into five broad domains based on international principles and developments across jurisdictions: governance, strategy, risk management, disclosures, and scenario analysis and stress testing. The key guidance associated with each category, summarised in the table below, is not intended to be prescriptive. Rather, they illustrate a range of supervisory approaches observed across international guidance and jurisdictions. Scenario analysis and stress tests are examined in greater detail in Chapter 3. While most supervisors have so far focused primarily on climate-related risks, rather than nature-related or broader ESG risks, these categories can generally be applied in a similar manner to nature-related risks. As supervisory frameworks continue to evolve, an increasing alignment between climate and nature-related risk guidance can be expected.

17 IAIS supervisory material refers to standards, such as the Insurance Core Principles (ICPs), whereas supporting material includes for instance application papers. The latter do not set new requirements or guidance, but provide further advice, illustrations, recommendations or examples of good practice to supervisors on how supervisory material may be implemented.

Table 5 **Supervisory guidance on climate and nature-related risks per category**

Governance	Supervisors expect financial institutions to clearly define and allocate responsibilities within existing governance arrangements. Supervisors acknowledge that governance arrangements need to be set up in a way that is appropriate within the financial institution's current organisational structure and risk profile. Board level commitment is critical to gain assurance that the work on climate and nature-related risks has sufficient standing in the organisation. It is also important that the board has a high-level understanding of the impact of the risks on the business, and that the board has the opportunity to respond to the risks strategically and provide the necessary oversight. These risks can be integrated in the fit-and-proper – or suitability – test used when approving appointments of board members, senior management and/or key persons in control/key functions (for example, Chair of Risk Committee, Chair of Audit Committee, Chief Risk Officer). Supervisors expect financial institutions to have policies, procedures and processes in place that ensure that the various business lines and relevant functions are attributed to clear roles and responsibilities within the climate-related and environmental risk management framework. More specifically, some supervisors have the mandate to assess the extent to which financial institutions' remuneration policies are in line with their long-term business goals as well as their risk appetite.
Strategy	Supervisors expect financial institutions to be aware of potential changes in their business environment and to adopt a strategic approach to cater for these risks. In the case of climate change and other nature-related pressures, the strategy also requires a longer-term view than the typical business planning horizon of three to five years. Such strategic planning can be supported by effective transition planning or the development of a transition plan. More generally, supervisors expect institutions to have the execution capabilities to ensure that the envisioned strategy for addressing these risks is cascaded down to individual business and product lines and operationalised. As there is inherent uncertainty about the way in which these risks will unfold, supervisors therefore typically expect financial institutions to test the resilience of their business model and capital adequacy against a plausible set of future scenarios.
Risk management	Supervisors approach climate and nature-related risks as drivers of established risk categories, such as credit, market, liquidity and operational risks. While insurance supervisors consider how climate-related risks may impact all the risk types which may impact insurers (for example, investment, underwriting, reserving, operational risks), banking supervisors tend to be most prescriptive on credit risk. Supervisors therefore expect that financial institutions develop adequate procedures to identify, assess, monitor, report and manage all material risks falling under these categories. Supervisors attach importance to the development of adequate metrics that enable the risk function to monitor the development of exposures to these risks, as well as derive management information to feed the discussions of the management board and make explicit an institution's risk appetite. Financial institutions are expected to develop metrics appropriate for their institution. While no single internationally agreed prudential standard exists for climate risk metrics, a degree of convergence has emerged around a set of commonly used indicators, including financed emissions, carbon intensity measures, portfolio alignment metrics, transition plan indicators and physical risk exposure metrics. In practice, a number of widely recognised frameworks and methodologies underpin these assessments, including the Partnership for Carbon Accounting Financials (PCAF) for financed emissions, the Science Based Targets initiative (SBTi) for science-based decarbonisation targets and transition plans, and PACTA (Paris Agreement Capital Transition Assessment) for portfolio alignment analysis. In addition, a growing set of transition-related indicators is being developed through global and regional disclosure frameworks, notably the International Financial Reporting Standards (IFRS) S2 Climate-related Disclosures Standard and the European Sustainability Reporting Standards (ESRS), which provide common reference points for assessing climate exposures, transition strategies and progress against climate objectives. Some supervisors acknowledge that the data needed for the development of these metrics are not readily available. They therefore encourage institutions to engage with their customers and other parties to develop the data infrastructure that is needed to measure the risks and expect appropriate proxies or estimates to be used where data is unavailable. However, when using proxy data and estimated values, the disclosure should include the data source, applicable conditions, key assumptions, and update frequency. Furthermore, principle-based guidance should be provided on internal independent verification of material indicators and, where necessary, external assurance. Lastly, several supervisors expect financial institutions to assess the extent to which climate-related or environmental risks may impact the capital adequacy of the institution going forward. Finally, supervisors point to the use of Internal Capital Adequacy Assessment Processes (ICAAP) of banks and Own Risk and Solvency Assessment insurers (ORSA) for insurers.
Scenario analysis	Supervisors may expect financial institutions to develop scenario analysis and stress testing to capture the magnitude of forward-looking climate and nature-related risks (Chapter 3). If a supervisor wants to be able to compare results between financial institutions, then it may specify not only the scenario, but also provide details of how financial institutions should perform the exercise and what assumptions they should make (for example, in respect of management actions).
Disclosures	Public disclosure by financial institutions pertaining to climate and nature-related risks and, more generally, supervisory engagement on Pillar 3 disclosures contribute to market efficiency by ensuring that market participants have adequate insight into risk exposures, risk assessment processes and capital adequacy of financial institutions. Several supervisors prescribe certain metrics to be disclosed, such as a portfolio breakdown of environmental risks by business line, geographic location or scope 1, 2 and 3 GHG emissions. Some supervisors also expect the disclosure of exposures contributing to sustainability objectives such as green and transition finance exposures. Authorities tend to refer to existing global or regional initiatives, such as the recommendations of the Task Force on Climate-Related Financial Disclosures or the International Sustainability Standards Board (ISSB). The global baseline standards issued by the ISSB, namely IFRS S1: General Requirements for Disclosure of Sustainability-related Financial Information (IFRS, 2023a) and IFRS S2: Climate-related Disclosures (IFRS, 2023b), provide a basis for the disclosure of sustainability-related risks and opportunities.

4.3 Developing supervisory guidance

The development of supervisory guidance typically takes between one and two years, although timelines and procedural requirements vary across jurisdictions. In most cases, the process includes a public consultation phase during which draft guidance is published and feedback is collected from stakeholders. In addition to written submissions, supervisors may organize industry roundtables and targeted discussions to facilitate dialogue with supervised institutions. Once finalized, the legal status and governance arrangements associated with supervisory guidance depend on the national regulatory framework. Supervisors have adopted a variety of instruments, including policy statements, supervisory statements, guidance documents, and compilations of good practices.

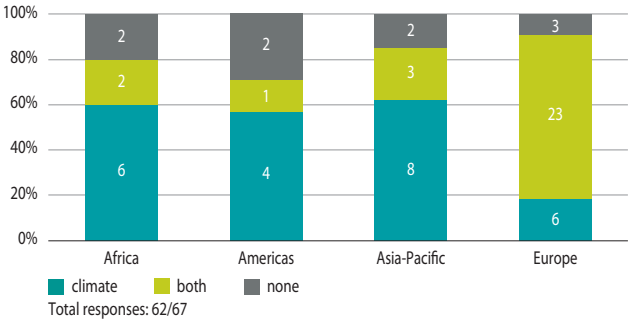
With regard to scope, the NGFS promotes an integrated approach to supervisory guidance. Such an approach encompasses both physical and transition risks associated with climate change while progressively extending to nature-related risks. This integration can be achieved organically by building on existing climate-related supervisory frameworks and gradually broadening them to capture wider environmental risk drivers and their interactions.

Supervisors design climate and nature-related supervisory guidance in accordance with the principle of proportionality. Guidance may vary depending on an institution's size, complexity, resources, and risk profile. For example, a large internationally active bank may be expected to conduct comprehensive climate stress testing, whereas a smaller institution may initially focus on its most material exposures. However, a smaller size does not necessarily imply lower climate or nature-related risks. A small financial institution may be highly concentrated in sectors or regions exposed to droughts, floods, biodiversity loss, or other environmental pressures. Supervisors may therefore expect even smaller institutions to assess their specific exposures and develop risk management practices commensurate with their risk profile. Proportionality also recognizes that institutions require time to develop and embed effective risk management practices. Accordingly, supervisors may take into account an institution's level of maturity, data availability, capabilities, and implementation plans when assessing progress. Where supervisory resources are limited, risk profiles may also be used to prioritize supervisory engagement, with greater attention devoted to institutions exhibiting higher concentrations of climate or nature-related risks. In applying the proportionality principle, regulators can recognize that developing economies may face significant data and technical constraints. To ensure the operability of "material exposure" assessments in data-constrained environments, regulators may permit financial institutions to use "alternative data", including macro proxy indicators and non-traditional open-source data. For example, supervisors may encourage the use of non-traditional open-source data such as satellite remote sensing and nighttime lights as proxy variables for physical risk exposure. They may also establish a qualitative indicator matrix (for example, regional climate vulnerability index, sectoral policy sensitivity score) as a tool for transition risk screening. Lastly, they may develop a risk monitoring methodology adapted to data-constrained environments. This approach can support a path to ensure that "material exposure" identification remains operational under data-limited conditions. In practice, supervisors typically calibrate guidance using a combination of traditional criteria – such as size, systemic importance, and business model complexity – and climate and nature-specific considerations, including the materiality of exposures, data quality, and risk management maturity. This approach reflects the evolving essence of climate and nature-related risk management and the need for flexibility as institutions continue to strengthen their capabilities.

Finally, supervisory guidance on climate and nature-related risks often starts at a high level and evolves as understanding of the risks, available methodologies and observed practices mature. This evolution can take different forms across jurisdictions. Some authorities progressively introduce more granular supervisory expectations and, in certain cases, more prescriptive requirements. For example, the **EBA** has complemented high-level principles with detailed guidelines and technical standards covering ESG risk management, transition plans and environmental scenario analysis. Others seek to maintain a principles-based framework while providing additional detail and clarity over time to support implementation. This is reflected, for example, in the **Bank of England Prudential Regulation Authority**'s Supervisory Statement SS5/25, which updates and clarifies the original SS3/19 expectations on managing climate-related financial risks while retaining a high-level and outcomes-focused approach. In both cases, the evolution of supervisory guidance is supported by a

more mature ecosystem of analytical tools and frameworks, including risk assessment methodologies, taxonomies, scenario analysis, transmission-channel mapping and risk mitigation practices.

Figure 12 **Supervisors defining supervisory guidance on climate and/or nature-related risks**



Source: NGFS Survey.

4.4 Implementing and monitoring supervisory guidance

Various stages can be adopted by supervisors to support implementation and supervisory follow-up of supervisory guidance. The steps described below correspond to observed practices across supervisors, mainly on climate-related risks. Nevertheless, similar steps can be applied for the assessment of supervisory guidance on nature-related risks. The stages are iterative and should not be interpreted as a strictly sequential process. They are nonetheless organised according to the typical progression of supervisory maturity and capabilities observed in the implementation and monitoring of climate and nature-related supervisory frameworks.

1. **Rising awareness about climate and nature-related guidance and sharing guidance:** Following publication of guidance, supervisory engagement is typically characterised by dialogue-oriented and guidance-based approaches. This aims at facilitating a comprehensive understanding of the guidance and the necessary steps for implementation. Supervisors may engage in structured and semi-structured interactions with financial institutions, utilising various platforms such as bilateral meetings, industry-wide forums, and workshops, to provide clarity on supervisory guidance, while encouraging financial institutions to develop the analytical capabilities, tools and methodologies required for effective implementation. At this stage of implementation, supervisory guidance is typically voluntary or being phased in and take the form of high-level supervisory guidance on emerging good practices and prudent risk management approaches. To strengthen the adoption of this supervisory guidance, supervisors may also complement technical engagement with high-level outreach to senior management or representatives of financial institutions. Such interactions can help reinforce the strategic importance of managing climate and nature-related risks, promote accountability at highest levels of governance, and highlight evolving good practices in the assessment and mitigation of such risks.

2. **Benchmarking progress:** To benchmark progress, supervisors often turn to self-assessment tools and structured surveys. This includes tools ranging from questionnaires, surveys, and self-assessment exercises to operationalize supervisory guidance. These instruments can require financial institutions to assess their current practices against supervisory guidance while providing authorities with structured and comparable information on the state of implementation. Where appropriate, supervisors may use these tools to identify common gaps and emerging practices and facilitate peer comparison. The information collected can also help supervisors better understand financial institutions' starting points, and tailor follow up actions such as targeted guidance, supervisory recommendations, or remediation plans in line with a proportionate approach. For example, the **Australian Prudential Regulation Authority** conducted periodic Climate Risk Self-Assessment Surveys for regulated financial institutions, with its 2024 publication being the latest (Australian Prudential Regulation Authority, 2024). These self-assessment surveys evaluate the maturity of financial institutions' practices against the Australian Prudential Regulation Authority's guidance on managing the financial risks of climate change, and enabled benchmarking of industry progress and identifying gaps in entity preparedness.

3. **Implementation phase:** To support effective implementation, supervisors may complement guidance with additional documentation and capacity-building initiatives. This may include technical notes, training programs for supervised financial institutions, as well as peer exchanges with other authorities and international organisations. These actions may be guided by the results of the surveys conducted in the previous phase, as it

identifies the areas of improvement. The availability, consistency, and quality of climate-related data is a key enabler of effective implementation by financial institutions. This often involves initiatives to support systematic collection of relevant information from financial institutions and their clients. Approaches include development of standardised data collection templates through industry collaboration, enhancements to prudential reporting frameworks or targeted surveys designed to capture exposures to physical and transition risks. Such initiatives can help establish common data baselines across financial institutions and improve comparability of information used in risk management and supervisory assessments. For example, following the publication of the Guidelines on Environment Risk Management in 2020 (effective 2022) by the **Monetary Authority of Singapore**, the Green Finance Industry Taskforce[18] developed the Environmental Risk Questionnaire – an industry-standard template – to support banks in engaging their corporate clients on environmental risk issues, and to facilitate more consistent data collection. In parallel, supervisors may also undertake data gap analyses and analytical exercises to better understand sector-wide exposures and inform the design of future supervisory tools.

4. **Supervisory engagement and ongoing monitoring:** Supervisors may require financial institutions to develop and submit implementation plans outlining how they intend to meet supervisory guidance. These plans may include indicative timelines and milestones, often set out in the supervisory guidance. For example, **Bank of England** Prudential Regulation Authority required firms to complete an internal review/gap analysis within six months of publication with an action plan to support firms own planning and progress towards meeting the guidance and helping supervisors hold firms to account on their plans and progress (Bank of England, 2025). The review of such plans can support supervisors in assessing preparedness, identifying potential shortcomings, and engaging with financial institutions on necessary adjustments. In some jurisdictions, implementation plans are complemented by periodic progress reports and updates, enabling supervisors to monitor developments over time. As supervisory guidance matures, some authorities are increasingly prepared to escalate their response when necessary. In some jurisdictions, supervisory guidance on climate have gradually become more stringent, evolving from voluntary guidance to increasingly binding supervisory requirements. While the survey reveals a relatively balanced distribution between binding and non-binding supervisory guidance globally, most respondents in Europe and Africa indicated that climate-related supervisory guidance is mandatory, with more than 60% reporting the existence of binding requirements. For binding requirements, enforcement measures are typically drawn from each jurisdiction's existing prudential toolkit, adapted to climate and nature-related risks. Qualitative supervisory actions are the most common initial step, for example, supervisors may issue formal recommendations or requirements instructing an institution to enhance specific aspects of its climate risk management or disclosures by a set deadline. These qualitative requirements are often communicated via supervisory letters or as part of the regular supervisory rating process (for example, affecting management component ratings or SRP scores) to ensure that shortcomings in meeting climate-related guidance are given the same rigor and follow-up as traditional risk issues. For example, after the 2022 climate risk assessment, the **European Central Bank** imposed binding supervisory obligations on non-compliant banks (for example, mandates to improve board oversight of climate-related risks or enhance scenario analysis capabilities), with progress monitored in subsequent examinations. Many European supervisors likewise stress that climate-related findings are fed into their existing supervisory frameworks, for instance, influencing the overall supervisory strategy for an institution or even leading to Pillar 2 supervisory measures (like additional capital requirements or capital buffers) if serious risk management gaps persist. Financial penalties or sanctions for climate-related issues have so far been rarely applied, as most authorities prefer to use persuasion and remediation before resorting to punishments.

18 The Green Finance Industry Taskforce (GFIT) was convened by MAS from November 2019 to April 2023 to help accelerate the development of green finance through four key initiatives: develop a taxonomy; improve disclosures; foster green finance solutions; and enhance environmental risk management practices of financial institutions. The Taskforce comprised representatives from financial institutions, corporates, non-governmental organisations, and financial industry associations. In January 2024, the Singapore Sustainable Finance Association was established to build on the work of GFIT.

Examples of the development and implementation of supervisory guidance across jurisdictions are presented in Case study 4. These case studies illustrate different approaches adopted by supervisory authorities to design, communicate, and operationalize climate and nature-related supervisory guidance, taking into account their differing institutional mandates, regulatory frameworks, and supervisory priorities.

Case study 4: Implementation and monitoring of supervisory guidance	
Morocco	**Bank Al-Maghrib** adopted a structured approach to integrate climate-related risks into banking supervision. It issued one of the earliest climate risk management circulars in the MENA region (Directive 5/W/2021). It also requires banks in its recent circulars (1/W/2025 and 2/W/2025) to disclose climate-related risks in line with ISSB standards and track large borrower's climate exposures by 2027. With World Bank support, Bank Al-Maghrib completed the MENA region's first climate risk assessment and stress test of its banking sector in 2024. It also incorporated climate-related risks into its (SREP). It may impose Pillar 2 capital buffers for banks with high climate risk exposures starting in 2027. This case offers insights into developing regulatory guidance in an emerging market, conducting climate stress-testing under data constraints, and using results to inform possible supervisory actions, such as additional capital requirements.
Brazil	Since 2021, **Banco Central do Brasil** has issued binding rules requiring banks to incorporate climate-related risks into governance, risk management, and Pillar 3 disclosures. Banco Central do Brasil has developed climate scenario analysis tools to aid supervisory work. Moreover, according to Banco Central do Brasil's regulation, financial institutions are required to conduct climate stress tests annually. Finally, Banco Central do Brasil has developed AI tools (LLMs) to help analyse banks' climate-related plans and reports.
European Union	The **European Central Bank** has adopted a risk-focused approach to foster alignment with supervisory guidance over time and ensure that banks adequately manage climate-related risks. Supervisory measures have included a range of options, with increasing levels of supervisory intensity, moving from qualitative guidance to the potential imposition of periodic penalty payments where banks fail to address supervisory findings within specified timelines. The ECB launched its multi-year programme in 2020, including the publication of its supervisory guidance in 2020 and the conduct of supervisory exercises, such as a bottom-up climate stress and thematic review in 2022. Following these exercises, the ECB encouraged banks to accelerate their progress, including through the establishment of clear interim deadlines. The follow-up included intensive ongoing monitoring, regular dialogue with institutions, and in some cases, issuing binding supervisory decisions. While supervised institutions have made considerable progress, supervisors will continue to follow banks' progress and remediation of shortcomings as part of their regular supervisory activities. In parallel, targeted supervisory exercises will focus on prudential transition planning requirements and persistent challenges to banks' compliance with the supervisory guidance and regulatory requirements for managing climate and nature-related risks. To help banks strengthen their risk management practices, the ECB also published a Compendium of Good practices in 2022 and an updated version in 2026. …/…

Jordan	The **Central Bank of Jordan** provides a structured example of how supervisory authorities in emerging markets can sequence the integration of climate related financial risks into prudential supervision. Central Bank of Jordan has progressively moved towards more formal supervisory guidance through the publication of Climate Risk Management Regulations (2025). These regulations introduce requirements for banks to integrate climate related risks into their governance structures, risk management frameworks, and internal processes. The regulatory framework emphasizes: • Board and senior management responsibility for overseeing climate related risks; • Integration of climate-related risks into existing risk categories (e.g., credit, market, and operational risks); • Development of internal risk assessment tools, including forward looking approaches where feasible; • Progressive improvement in data collection, monitoring, and internal reporting. The regulations follow a proportional and phased approach, allowing financial institutions time to build the necessary data, tools, and expertise. This sequencing reflects the realities of capacity and data constraints typical of emerging markets, while still setting a clear direction of travel toward more advanced supervisory practices.

4.5 Supervisory guidance regarding transition planning and transition plans

Supervisors are increasingly developing supervisory guidance related to transition planning and transition plans. The NGFS distinguishes between transition planning and transition plans. Transition planning refers to the continuous process through which an institution develops, implements and updates its strategy for managing climate-related risks and opportunities. A transition plan is the resulting articulation of that process, setting out the institution's objectives, actions, governance arrangements and implementation pathway. From a supervisory perspective, the focus is often not only on the plan itself, but also on the underlying transition planning process, as the credibility of a transition plan depends on the governance, risk management and strategic processes supporting it.

Supervisory guidance generally focuses on transition planning and some supervisory authorities have issued dedicated guidance regarding transition planning. This includes governance arrangements, strategic planning, risk appetite, risk management processes, metrics and targets, and the integration of climate-related considerations into institutions' strategies and business models. For example, in the European Union, prudential transition plans have been incorporated into the banking regulatory framework through CRD VI and the **European Banking Authority** Guidelines on the management of ESG risks. The **European Central Bank** has also highlighted the importance of transition planning as a means for banks to assess and manage the implications of different transition pathways for their risk profile and business strategy. Similarly, in March 2026, the **Monetary Authority of Singapore** (MAS) issued three sets of Guidelines on Environmental Risk Management – Transition Planning, which separately set out supervisory expectations for banks, insurers, and asset managers to manage the transition and physical risks arising from climate change as part of a sound transition planning process. The guidelines serve as an addendum to the Guidelines on Environmental Risk Management issued in 2020, and set out expectations for financial institutions to establish a transition planning process in a risk proportionate manner, taking into consideration various factors, such as the risk profiles of their business models and the local circumstances of their business operations.

Other authorities have embedded transition planning guidance within broader supervisory frameworks for climate-related risks. For example, the **Bank of England** has emphasised the need for firms to develop credible strategic responses to the transition to a lower-carbon economy and to incorporate transition considerations into governance and risk management arrangements. Likewise, **Bank Negara Malaysia** expects financial

institutions to assess the implications of climate change for their business activities and to integrate transition-related considerations into their governance, strategy and risk management frameworks. Bank Negara Malaysia adopts a climate transition planning approach centred on risk management, financial resilience, and an orderly transition to a low-carbon economy. BNM's approach is underpinned by the Climate Change and Principle-based Taxonomy (CCPT) (2021) and the Climate Risk Management and Scenario Analysis (CRMSA) policy document (2022), which establish expectations for risk assessment, scenario analysis, and climate-related decision-making. Through the Joint Committee on Climate Change (JC3), BNM also supports capacity building, transition planning, and sustainable finance initiatives to help financial institutions facilitate a just and orderly transition while safeguarding financial stability. **Banco Central do Brasil** has proposed expanding the mandatory Social, Environmental and Climate Risks and Opportunities Report (GRSAC) to align with the BCBS's voluntary climate disclosure framework and complement IFRS Sustainability Disclosure Standards. Expected to be adopted in 2026, the proposal strengthens and standardizes quantitative disclosures on transition and physical risks, risk management practices and voluntary commitments, while extending requirements to smaller institutions.

It is also important to recognise that many supervisory authorities have not, to date, developed specific supervisory guidance regarding transition plans. In such cases, supervised institutions may choose to develop and disclose transition plans on a voluntary basis or by drawing on internationally recognised frameworks and guidance. Examples include the recommendations developed by the **UK Transition Plan Taskforce** (TPT), which have progressively informed international sustainability reporting and disclosure frameworks, including those developed by the ISSB. As supervisory approaches continue to evolve across jurisdictions, improving the interoperability and comparability of transition plans is becoming increasingly important, particularly for internationally active financial institutions. International reference frameworks, including the BCBS' voluntary framework on climate-related risk disclosures, can provide an important global reference point for promoting greater consistency in climate-related risk disclosures. Chapter 5 discusses how transition plans can be used by supervisors as a potential micro-prudential tool.

While existing transition plan frameworks still largely focus on climate-related risks, guidance is beginning to emerge to include nature targets and risks in transition planning and transition plans (TNFD, WWF, etc.).[19] All guidance acknowledges the need for an integrated approach, with a single plan encompassing both climate and nature considerations. However, having an effective supervisory oversight of nature transition plans may require advancements with respect to the understanding of nature-related risks, developing relevant data and scenarios, and creating methodologies for robust target settings. Compared with climate transition planning, methodologies for nature-related targets, pathways and metrics remain at a much earlier stage of development and are not yet used by most supervisors.

Guidance on transition planning and transition plans does not operate in isolation but interacts closely with other elements of supervisory frameworks, such as portfolio alignment metrics, climate scenario analysis and risk management expectations. These elements can inform the development and assessment of transition plans, while transition plans provide the forward-looking assumptions and strategic information needed to support such analyses. Together, they form a coherent and mutually reinforcing framework that supports the management of climate-related and environmental risks and helps shape the substance of credible transition planning (CETEx, 2025c).

19 Most guidance are mainly focuses on corporates rather than financial institutions' needs.

4.6 Supervisory guidance regarding nature-related risks

Nature-related risks remain only partially integrated into supervisory guidance. Nevertheless, the topic has gained increasing attention among financial authorities in recent years. In 2024, the **Financial Stability Board** (FSB) conducted a global stocktake of supervisory and regulatory approaches to nature-related risks, highlighting the growing recognition of these risks within prudential frameworks and the increasing number of initiatives undertaken by regulatory and supervisory authorities worldwide.

Supervisory initiatives to set out guidance related to nature-related risks have already emerged. In 2020, the **ECB** issued supervisory guidance covering both climate-related and environmental risks. In the insurance sector, **EIOPA** published its Staff Paper on Nature-related Risks and Impacts for Insurance in 2023, which examines the transmission channels through which nature degradation may affect insurers and outlines potential future supervisory guidance (EIOPA, 2023b). The paper also discusses the gradual integration of nature-related risks into insurers' risk management frameworks and ORSA. The **Swiss Financial Market Supervisory Authority** (FINMA) issued its Circular on Nature-related Risks in December 2024 which sets out supervisory guidance for banks' and insurers' management of both climate-related and broader nature-related risks covering governance, risk identification, materiality assessment, risk management processes, and the use of scenario analysis. It entered into force on 1 January 2026 and initially applies to climate-related risks, while its scope will be extended to all nature-related risks from 1 January 2028. It represents one of the first prudential supervisory initiatives explicitly addressing nature-related risks beyond climate change.

Survey results also suggest that generally supervisory practices are beginning to evolve in this direction. Around 40% of surveyed authorities reported considering nature-related risks in addition to climate-related risks. Although supervisory guidance in this area is not always formally published or legally binding, these developments point to a growing willingness among supervisors to address a broader range of nature risk drivers within prudential supervision.

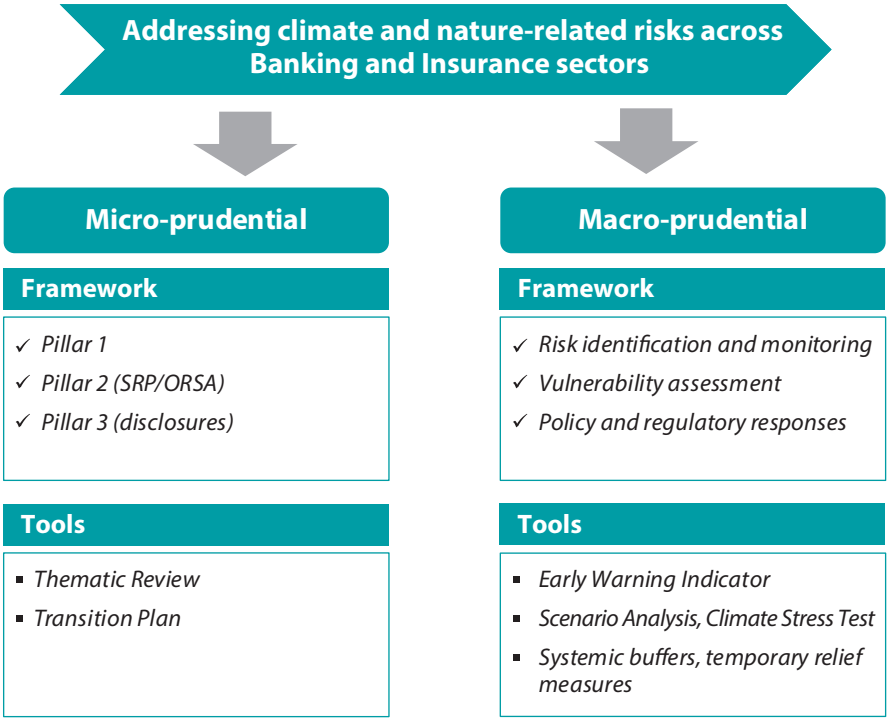
These initiatives build on a growing body of international work. For example, the *NGFS Conceptual Framework on Nature-related Financial Risks* (NGFS, 2024a) and the *NGFS Note on the Supervision of Nature-related Financial Risks* (NGFS, 2026a) promotes an integrated supervisory approach for incorporating nature-related risks into existing supervisory processes (Section 1.3).

5. Prudential framework and tools

This chapter presents the prudential frameworks applied across the banking and insurance sectors, structured around the three pillars of prudential regulation. It first examines the role of Pillars 1, 2 and 3 in addressing climate and nature-related risks. It then discusses a range of micro-prudential supervisory tools and helpful inputs that can be used to assess these risks, such as thematic reviews and transition plans. Finally, the chapter considers the use of macro-prudential tools aimed at monitoring system-wide vulnerabilities arising from climate and nature-related risks. While most of the examples and practices discussed in this chapter relate to climate-related risks, many of the underlying prudential approaches and supervisory tools can also be adapted to address a broader range of nature-related risks.

Recommendation 5 – Ensure adequate management of climate and nature-related risks by financial institutions and take mitigating supervisory action where appropriate, including by considering how such risks may be addressed within the prudential framework.

Figure 13 **Prudential framework and tools to assess climate and nature-related risks – High level summary**



5.1 Micro-prudential framework

This chapter examines the supervisory frameworks, including the three-Pillar prudential architecture for the banking and insurance sectors and how they cover climate and nature-related risks. Rather than creating entirely new supervisory regimes, jurisdictions have progressively integrated climate and nature-related risks into existing prudential frameworks, building on the guidance developed by the BCBS and IAIS. This section first examines climate-related risks before turning to nature-related risks.

5.1.1 Pillar 1

Pillar 1 sets standardised minimum capital requirements for the main financial risk categories. For the banking sector, the BCBS has clarified how climate-related risks can be captured within the existing Pillar 1 framework, notably through their transmission channels to credit, market and

operational risks, while noting no changes to minimum capital requirements at this stage and encouraging iterative improvements as methodologies and data evolve (BCBS, 2022a; BCBS, 2022b). These clarifications aim to promote a consistent international interpretation of the current guidance, for example by incorporating climate-related risk drivers into assessments of counterparty creditworthiness or by reflecting climate-related data limitations in internal rating systems, without introducing new capital requirements. In the insurance sector, Pillar 1 encompasses quantitative requirements aimed at ensuring the financial resilience of insurers. It includes the valuation of assets and liabilities, the calculation of technical provisions, and the determination of capital requirements to absorb potential losses. The objective is to ensure that insurers maintain sufficient financial resources to meet their obligations to policyholders, including under adverse conditions. Certain physical risks are already incorporated into Pillar 1 requirements through natural catastrophe risk modules. These modules aim to capture insurers' exposure to losses arising from severe natural hazards through risk-based capital requirements. As a result, elements of climate-related physical risk are already reflected in Pillar 1, where they are adequately captured by existing catastrophe risk calibrations and modelling assumptions. However, these frameworks were generally not designed with the specific purpose of addressing the evolving nature of climate change and may not fully capture the frequency, severity, and geographical distribution of future climate-related hazards. Consequently, supervisory authorities and standard-setting bodies continue to assess whether, and to what extent, enhancements to natural catastrophe risk modules, modelling approaches and underlying assumptions may be warranted to ensure that climate-related physical risks remain appropriately reflected in prudential frameworks.

Only a few supervisors have introduced dedicated Pillar 1 capital adjustments. Commonly cited challenges include uncertainty regarding risk calibration, limited availability of historical and forward-looking data, difficulties in ensuring cross-jurisdictional comparability, and the need to maintain consistency with existing risk-based capital frameworks. While analytical work continues to assess whether certain climate-related exposures may exhibit distinct risk characteristics, no broad international consensus has emerged on the appropriateness or design of climate-specific capital treatments. As a result, the integration of climate-related risks into Pillar 1, for example, the recalibration of risk weights (including internal ratings-based[20]) or the introduction of dedicated capital requirements, remains challenging at this stage. International work on potential Pillar 1 approaches is ongoing, particularly in the banking sector, with a focus on improving risk measurement, strengthening the evidence base, and assessing the extent to which climate-related risks are adequately captured within existing prudential frameworks.

5.1.2 Pillar 2

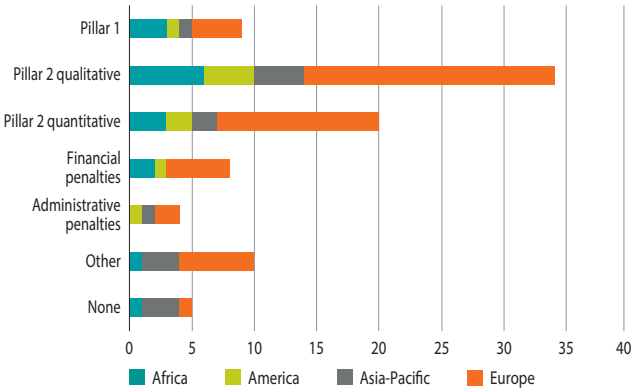
Climate-related risks can be assessed under Pillar 2.[21] The assessment of corporate governance, as well as those risks that are considered under Pillar 1 but not fully captured by Pillar 1 capital requirements, is particularly important under Pillar 2 (BCBS, 2019). This is particularly relevant for climate-related risks, given the challenges associated with their measurement and incorporation into Pillar 1 standards. Banks are expected to integrate material climate-related risks into their ICAAP and Internal Liquidity Adequacy Assessment Process (ILAAP). Supervisors, in turn, assess these risks through the SRP, evaluating whether banks' governance, risk management practices, capital and liquidity positions are commensurate with their risk profile, including climate-related exposures. Similarly, in the insurance sector, Pillar 2 focuses on governance and risk management requirements. Climate-related risks are therefore expected to be integrated into governance frameworks, risk appetite statements, enterprise risk management processes, scenario analysis and strategic decision-making. A key Pillar 2 instrument is the ORSA, through which insurers assess, on a forward-looking basis, their overall risk profile, solvency needs and capital adequacy, including the potential implications of emerging risks such as climate change.

20 The internal ratings-based (IRB) approach allows banks, subject to supervisory approval, to use their internal credit risk models to estimate key risk parameters and calculate their Pillar 1 capital requirements, instead of relying solely on the standardized approach.

21 The Pillar 2 supervisory review process is intended to ensure that financial institutions not only have adequate capital to support all the risks in their business but also develop and use better risk management techniques in monitoring and managing these risks.

Supervisors primarily rely on Pillar 2 to address climate-related risks. Pillar 2 provides a flexible mechanism through which supervisors can address institution-specific risks. This flexibility makes it a particularly relevant tool for the prudential treatment of climate-related risks, given the uncertainty surrounding their quantification, the long-time horizons involved, and the heterogeneity of institutions' exposures. Where climate-related risks are considered material and are not adequately addressed by an institution's risk management framework, Pillar 2 enables supervisors to take proportionate supervisory action. This may include qualitative measures, targeted remediation plans, heightened supervisory engagement, or, where justified, institution-specific capital requirements. In this way, Pillar 2 allows supervisors to exercise judgement and reflect the specific risk profile and vulnerabilities of individual institutions, while preserving the risk-sensitive nature of the prudential framework and avoiding broad-based capital adjustments that may not accurately reflect underlying risks (European Banking Authority, 2023). According to the NGFS survey responses, most supervisors make use of the qualitative components of Pillar 2. The second most frequently used approach is the quantitative component of Pillar 2, through which supervisors may assess how climate-related risks are reflected in capital adequacy assessments and, where appropriate, impose institution-specific prudential measures.

Figure 14 **Options considered by supervisors surveyed to mitigate climate and nature-related risks**



Total responses: 54/67
Multiple-choice question
Other: engagements, systemic risk buffer, decisions…

Source: NGFS Survey.

Examples of the explicit use of green or brown factors remain exceptional, under Pillar 2. The introduction of green supporting or brown penalising factors is the subject of international debate (Case study 5.1).

Case study 5.1: Green supporting factor and brown penalising factor under Pillar 2

Prudential applications have been confined to green supporting measures, while no jurisdiction has implemented explicit brown penalising capital factors to date. This reflects persistent concerns regarding calibration, potential unintended consequences, and the risk of introducing blunt adjustments in the absence of sufficiently robust empirical evidence. Hungary provides an illustrative example of a green supporting approach. Introduced as part of the ICAAP/SREP process, **Magyar Nemzeti Bank** allows banks to obtain a reduction in their Pillar 2 capital requirements for eligible green exposures (such as renewable energy projects, energy efficiency improvements, sustainable transport investments and green housing), thereby incentivising green lending without modifying Pillar 1 risk-weight calculations. More specifically, it includes reductions in capital requirements of 5-7% for gross eligible exposures, alignment with recognised taxonomies or standards, dedicated reporting requirements, prudential caps, and periodic reviews to ensure that the programmes do not give rise to material financial stability risks. The programme is supported by research conducted by the Magyar Nemzeti Bank (Várgedő, B., Burger, Cs., Kim, D., 2024), which found that firms benefiting from green loans – particularly for renewable energy and electromobility projects – exhibit significantly lower credit risk than non-green firms. Both logistic default probability models and survival analyses indicate a lower likelihood of default among green firms. …/…

Conceptual developments around brown penalising factors have also emerged in policy and academic discussions. These approaches seek to reflect the potentially higher risk profile of carbon-intensive exposures within prudential frameworks by increasing capital requirements or imposing other prudential constraints on activities considered particularly exposed to transition risks. One such approach is the introduction of so-called "cap dirty" measures, which would impose higher capital requirements on carbon-intensive exposures. Other proposals include concentration limits or capital surcharges designed to constrain banks' aggregate exposures to carbon-intensive sectors, as well as sectoral systemic risk buffers and sectoral leverage requirements. These approaches can be motivated by concerns that carbon-intensive activities may be associated with elevated transition-related risks and may generate negative externalities that could contribute to broader risks for the financial system. By increasing the prudential cost of such exposures, these measures seek to strengthen the resilience of financial institutions to potential transition shocks and to mitigate the build-up of climate-related vulnerabilities.

The design and calibration of these tools require careful consideration. Such measures would need to be calibrated in a manner that appropriately reflects underlying risks while avoiding unintended consequences, such as amplifying transition risks, encouraging abrupt market adjustments, or undermining broader public policy objectives, including access to credit for certain sectors, firms or households. One key consideration relates to the scope of application, notably whether measures should apply only to new lending or to the entire stock of existing exposures. Applying such measures to new loans may facilitate risk-sensitive calibration and encourage more prudent underwriting practices, whereas extending them to existing portfolios could provide a more immediate prudential effect but may also increase the risk of abrupt portfolio adjustments and disorderly asset reallocation. To mitigate these risks, authorities could consider phased implementation arrangements. Another important design choice concerns the level at which such measures are applied. A firm-level approach would assess the overall emissions profile and transition strategy of a counterparty to determine the prudential treatment of its exposures. In contrast, a project-level approach would allow banks to distinguish between activities that support the transition to a low-carbon economy and other forms of financing provided to carbon-intensive entities. This approach could help preserve incentives for transition finance by recognising investments that contribute to the decarbonisation of business models. A broader challenge relates to coordination and transition dynamics. If prudential measures significantly increase the cost or reduce the availability of financing for carbon-intensive firms, they could inadvertently constrain the ability of those firms to invest in their transition, thereby increasing rather than reducing transition-related risks over the longer term. This highlights the importance of carefully balancing risk-based prudential objectives with the need to support orderly economy-wide transition pathways.

Supervisory Review Process (SRP)

The SRP is a key Pillar 2 mechanism through which supervisors can assess the adequacy of financial institutions' management of climate-related risks. By reviewing governance arrangements, risk management processes, scenario analysis capabilities, data quality and exposure to stranded assets, the SRP helps ensure that emerging climate-related risks are effectively incorporated into institutions' overall risk profiles and capital planning.

Case study 5.2: How Banca d'Italia integrates climate and nature-related risks into SREP[1]

Banca d'Italia's "Supervisory guidance for climate-related and environmental risks" (Banca d'Italia, 2022a) represent a general non-binding guidance relevant for climate and nature-related risks. **Banca d'Italia has fully integrated climate and nature-related risks into the supervisory dialogue with banks and financial intermediaries, according to the proportionality principle, with routine discussions with individual intermediaries on the extent to which they meet guidance and on their action plans.**

.../...

The information collected in the supervisory dialogue is included into the SREP, primarily in "Internal Governance and Risk Management" and "Business Model & Profitability" components. In case of severe delays in the action plans implementation, supervisory action is strengthened with the aim of ensuring that corporate practices are progressively aligned with current guidance.

Practical examples drawn from Supervisory guidance for climate-related and environmental risks that are also of relevance for the purposes of the SREP assessments include:

- for "Internal Governance and Risk Management": "The management body of intermediaries plays an active role in steering and governing the integration of climate-related and environmental risks into the corporate culture and strategy and, where applicable, into the corporate risk appetite framework, within the risk limits of the portfolios managed, consistently defining the main corporate policies and the adaptation of organizational and management systems. In this regard, the management body approves an appropriate action plan."
- for "Business Model & Profitability": "In order to ensure the resilience of their business model and guide its development prospects, in drawing up and implementing their business plan, intermediaries identify climate-related and environmental risks that could affect the business environment, understanding and measuring their potential impacts."

Banca d'Italia expects the intermediaries to be able to assess the materiality of climate-related, environmental, physical and transition risks that could affect the business conditions. Materiality, understood as the ability to influence the sustainability of current and future corporate returns, own portfolios and those managed on behalf of third parties, must be determined in accordance with the principle of proportionality, taking into account the complexity, risk profile and type of business model.

The impact of investment activity on the environment must also be identified. Once risks have been identified, intermediaries are expected to understand and measure their impact on the business environment, in the short, medium and long term, also in order to steer strategic choices and thus ensure the resilience of the business model. Indeed, it is important that intermediaries take into account the results of the impact analysis in their strategic planning, defining key performance indicators and monitoring their achievement.

Climate-related and environmental risks can have effects beyond the usual timeframe for strategic planning, for example in line with public policy commitments to transition to a more sustainable economy. In this context, although intermediaries are not required to change the time horizon of strategic planning, they are encouraged to integrate the outcomes of longer-term analyses of climate-related and environmental risks into their planning processes.

The follow-up insights derived from dedicated surveys, and additionally incorporated into SREP processes, are also employed within a broader feedback loop at system level. In particular, Banca d'Italia promotes system-wide convergence by publishing and disseminating good practices for banks (Banca d'Italia, 2022b; Banca d'Italia, 2025a) and non-bank intermediaries (Banca d'Italia, 2022c; Banca d'Italia, 2025b), with the aim of strengthening overall resilience.

Examples of good practices referred, with regard to:

- "Internal Governance and Risk Management": update of the Board of Directors' responsibilities and their articulation within governance mechanisms; adjustment of the organisational structure; professional expertise of the management body; Risk Appetite Framework (RAF), Key Risk Indicators (KRIs) and reporting; data acquisition process; reviews carried out by internal control functions; introduction of "green" indicators in remuneration policies;
- "Business Model & Profitability": analysis of the reference operating environment, in terms of transition risks and climate-related vulnerabilities; strategic initiatives within the business plan, including products or services to facilitate the green transition; quantitative performance indicators.

1 The Supervisory Review Process (SRP) is a broad concept applied across jurisdictions globally, whereas the Supervisory Review and Evaluation Process (SREP) refers specifically to the EU supervisory framework.

Internal Capital Adequacy Assessment Process (ICAAP)

A growing number of financial institutions are progressively incorporating climate-related risks into internal capital frameworks, including ICAAPs.[22] These developments remain at an early stage but provide insight into how risk quantification, scenario analysis, and capital planning interlink. Observed practices include overlays to probability of default (PD) and loss given default (LGD) parameters for portfolios exposed to climate-related vulnerabilities, scenario-based capital add-ons targeted at unmitigated risk concentrations, and internal economic capital overlays reflecting transition, physical-related risks. The increase in capital is generally modest in scale relative to total internal capital. Institutions often complement quantitative metrics with qualitative assessments to manage uncertainty, data gaps and model limitations. While these practices have not yet been standardised, they illustrate emerging approaches to reflect climate-related risks within capital management.

Own Risk and Solvency Assessment (ORSA)

The ORSA can help insurers assess the potential impact of climate-related risks on their specific risk profile. This includes underwriting risks, reserves, reinsurance arrangements, asset and liability management, operational resilience, solvency needs and business model sustainability. Supervisors can therefore expect insurers to consider how broader physical and transition risk factors might affect the frequency and severity of claims, the adequacy of technical provisions, the availability and cost of reinsurance, and the consistency between the insurer's risk appetite and its underwriting strategy. Similarly, supervisors can expect insurers to consider the impact of climate-related risks on other parts of their balance sheet, in particular on their investments and life and health insurance liabilities. More broadly, supervisors can assess whether ORSA findings are effectively linked to strategic decision-making, capital management, and risk appetite frameworks. The ORSA should be viewed not only as a solvency assessment exercise but also as a forward-looking management tool that enables insurers to understand the long-term implications of environmental risks and to demonstrate the sustainability of their business model. Supervisors may assess whether the ORSA includes:

- identification of climate-related risk drivers;
- materiality assessments covering underwriting, investments and operations;
- assessment of physical and transition risks across multiple time horizons;
- scenario analysis and stress testing based on plausible environmental pathways;
- evaluation of risk mitigation and adaptation measures;
- assessment of impacts on solvency, liquidity, profitability and business strategy;
- consideration of management actions and contingency plans; and
- integration of ORSA findings into risk appetite, governance and strategic planning processes.

Where material climate-related exposures exist, supervisors may expect these risks to be reflected in the ORSA through scenario analysis and stress testing (EIOPA, 2022). Supervisory reviews may assess whether insurers consider both short- and long-term horizons and analyse a range of plausible pathways, including orderly and disorderly transition scenarios or scenarios characterised by severe physical risk impacts. The purpose of these exercises is not to predict future outcomes, but to evaluate the resilience of the insurer's strategy, risk profile, capital position, and business model under different environmental conditions (Chapter 4).

The ORSA can also provide supervisors with insights into the effectiveness of insurers' risk mitigation and adaptation measures. Supervisors may assess how insurers evaluate actions such as underwriting restrictions in carbon-intensive sectors, portfolio decarbonisation strategies, reinsurance arrangements, client engagement initiatives, geographic diversification, prevention measures or changes to pricing and reserving methodologies. Attention can be given to whether insurers can demonstrate that these measures reduce residual exposures and strengthen resilience under adverse scenarios.

22 ICAAP requires banks to assess, on a forward-looking basis, the adequacy of their capital relative to their overall risk profile, and feeds into the SREP.

Integration of adaptation and mitigation into Pillar 2

Supervisors have progressively incorporated assessment of mitigation measures into their risk assessment frameworks. Mitigation measures may correspond to sectoral financing targets set by financial institutions or restrictions for activities that are particularly exposed to transition risks (for example, exclusion policies, portfolio limits, or enhanced due diligence requirements). Financial institutions may also seek to reduce financed emissions by supporting the transition efforts of their clients and counterparties through sustainable lending products, transition finance instruments, and engagement strategies. Most supervisors participating in the NGFS survey (62%) reported taking mitigation measures into account through qualitative Pillar 2 assessments. This qualitative approach provides greater flexibility in evaluating the relevance, credibility, and effectiveness of such measures. A smaller share of supervisors reported considering mitigation measures within quantitative Pillar 2 assessments (37%), while a limited number indicated that they are directly reflected in Pillar 1 requirements (15%).

By contrast, assessment of adaptation measures appears to be less systematically integrated into supervisory risk assessments. Adaptation measures are actions, investments, policies or changes in practices aimed at reducing the adverse impacts of climate change and increasing the resilience of human, natural and economic systems to physical climate risks (NGFS, 2024c). Examples include coastal protection infrastructure, climate-resilient agriculture, sustainable water management systems, heat-resilient buildings that help households, firms and public authorities better withstand climate-related shocks. These measures can reduce physical losses and strengthen economic resilience. The NGFS does not consider insurance to be an adaptation measure in the strict sense, as insurance does not reduce the physical impacts of climate change and thus, the underlying risk. Instead, insurance is viewed as a risk-transfer and recovery mechanism that complements adaptation by improving financial resilience, facilitating post-disaster recovery and helping to mitigate macroeconomic losses. The NGFS nevertheless highlights strong complementarities between adaptation and insurance, as effective adaptation measures can reduce climate losses and support the long-term insurability of climate-exposed activities.

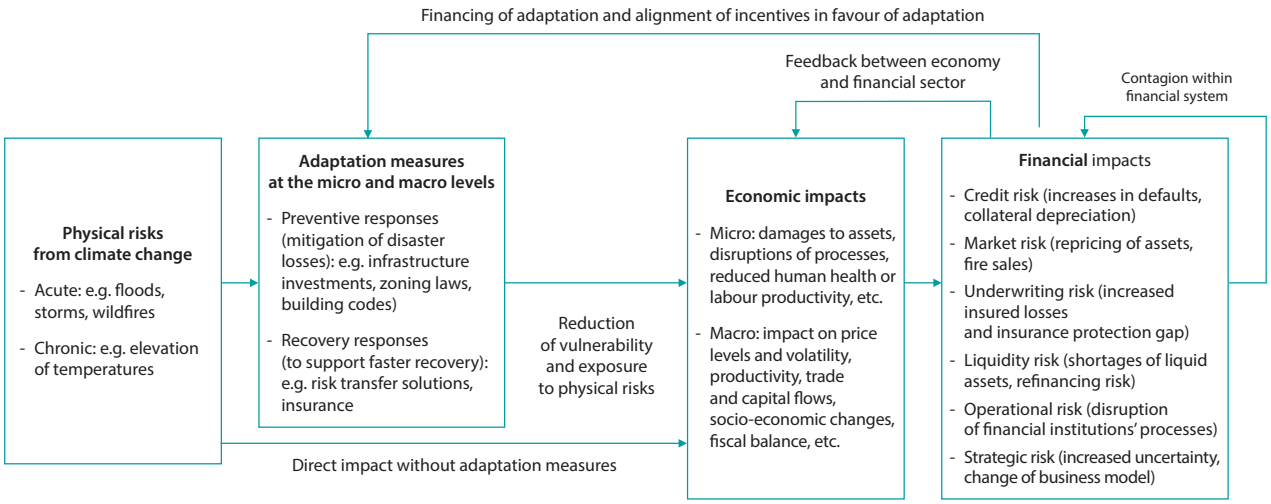
Initiatives are emerging to incorporate directly adaptation measures into supervisory assessments. For instance, the **Palestine Monetary Authority** evaluates adaptation measures implemented by financial institutions through a combination of interviews, reviews of reported information, and high-level qualitative indicators. At this stage, the assessment remains primarily qualitative, focusing on institutional awareness, governance arrangements, and early adaptation practices rather than on the quantitative measurement of impacts. The **Autorité de Contrôle Prudentiel et de Résolution** has also integrated adaptation considerations into its climate stress-testing framework. The exercise examined insurers' adaptation strategies in response to the impacts of climate change and allowed participating insurers, under the long-term scenario, to implement management actions aimed at mitigating the effects of adverse climate pathways, such as geographical portfolio reallocation or the discontinuation of coverage in selected areas. In addition, the exercise included a qualitative questionnaire covering governance, underwriting policies, pricing practices, prevention measures, reinsurance strategies, risk appetite indicators, zoning issues, and potentially uninsurable areas, with 13 insurers participating in the survey. Technical box 6 highlights why the assessment of adaptation measures is important for supervisors and explores potential avenues for further integrating adaptation considerations into supervisory frameworks.

Technical box 6

Relevance and challenges of adaptation for supervisors

Why is adaptation relevant for supervisors? The costs associated with acute and chronic physical risks have increased over the past decades. The destruction of assets due to natural catastrophes amounted to USD 318 billion in 2024, with wildfires, flooding and severe thunderstorms accounting for over 96% of insured losses (Swiss Re, 2025). These economic costs, which have doubled between 2001 and 2020, are expected to intensify even in a scenario where emissions are reduced to net zero by 2050 (UNDRR, 2025). The Intergovernmental Panel on Climate Change (IPCC) in its 6th Assessment Report warns that in the near term, every region in the world is projected to face further increases in climate hazards, increasing multiple risks to ecosystems and humans (IPCC, 2023). Adaptation measures can limit the economic and financial impacts of climate-related physical risks. These measures consist of adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which can enhance the resilience of an activity. Successful adaptation measures reduce exposure and vulnerability to the impacts of climate change and nature degradation. Financial institutions may have an interest in adjusting their risk management systems and assessing the adaptation measures implemented by their clients and counterparties. Indeed, such adjustments may lead to reduced exposures to climate and nature risks, which would subsequently contribute to reduced expected losses, increased repayment capacity and the preservation of collateral values. In turn, supervisors may also seek to understand the credibility of how financial institutions consider gross risk (physical risks) and net risk (mitigated by adaptation measures) affecting their balance sheets.

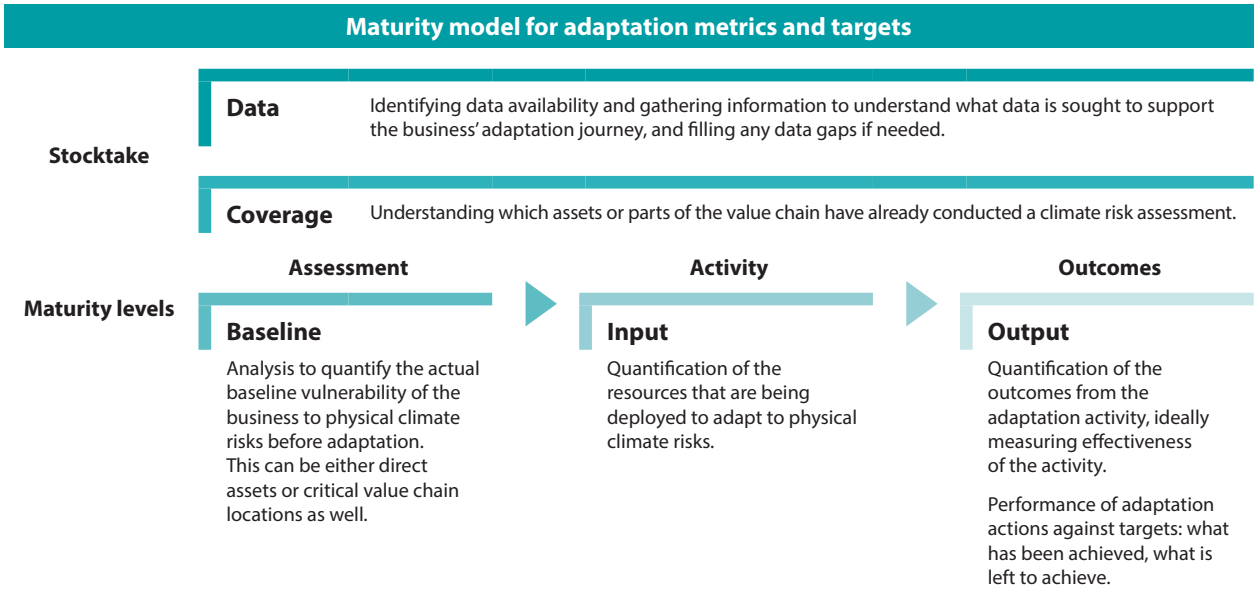
Figure 1 **Financing of adaptation measures reduces vulnerability and physical risk exposure**



Source: Adapted from Svartzman, R. et al. (2021), A "Silent Spring" for the Financial System? Exploring Biodiversity-Related Financial Risks in France. Economic and financial impacts of physical risks and adaptation measures (NGFS, 2024c).

How can adaptation be considered within financial risk management by supervisors? Central banks and supervisors can play an active role by encouraging better risk management practices within the financial system. This can include embedding adaptation into regulatory frameworks, transition plans, investment and lending portfolio decisions, and climate scenarios. For example, transition plans can serve as a tool to facilitate a strategic approach to the assessment and management of physical risks and integrate adaptation actions aligned with broader institutional and systemic resilience objectives. The NGFS has introduced a practical approach for embedding adaptation and resilience into transition plans, including a "maturity pathway" (NGFS, 2025c).

.../...



Source: Maturity model for adaptation metrics and targets (NGFS, 2025c).

Unlike adaptation measures, which seek to directly reduce the costs associated with physical climate risks, insurance primarily redistributes those costs across policyholders, insurers and, in some cases, public authorities, thereby enhancing financial resilience without reducing the underlying hazard. Therefore, supervisors may also seek to assess levels of insurance penetration, as it may provide a form of financial resilience that mitigates the economic impacts of extreme weather events. This assessment should help ensure that supervised institutions do not overestimate the availability or reliability of insurance coverage over time, as climate-related physical risks increasingly materialise (CETEx, 2026c). At a minimum, banks should be able to identify which assets are insured, to what extent, and against which hazards, as well as which losses they would bear without insurance and government support. To this end, supervisors can ask banks to collect, compare, and store insurance data, drawing on public data sources, client disclosures and third-party providers. It is also important to explore how the role of banks in incentivising adaptation measures can be strengthened. Banks could integrate climate and physical risk considerations at the point of loan origination, including an assessment of the future insurability of projects, for example through cooperation with insurers. This would contribute to continued availability of insurance coverage throughout the lifetime of the loans. Whilst itself not an adaptation measure, the pricing of insurance against natural perils may serve as a powerful mechanism for encouraging the adoption of adaptation measures, thereby fostering a favourable environment for price and financial stability.

Where part of their mandate, central banks and supervisors can also contribute to scaling up the financing of adaptation *via* policy support. For example, supervisors could develop metrics and tools for better measurement and disclosure of adaptation. They could also explore the need to enhance policy, supervisory, and regulatory frameworks (e.g., integrating adaptation into transition plans, climate scenario analysis, stress tests, credit risk assessments, or insurers' provisioning requirements). Finally, central banks and supervisors may also engage with a broad set of public and private stakeholders to help foster such an environment such as for developing standardised disclosure requirements and public private partnerships for insurance schemes (NGFS, 2024b).

What are the key challenges? Integrating adaptation measures into risk assessments is still constrained by gaps in data, differing definitions and methodologies across sources, and the limited availability of clear, decision-useful indicators. The long-term and preventive nature of adaptation further complicates this, as its benefits often

.../...

materialize over extended time horizons and their impacts on potential losses is not straightforward to estimate. These factors compound the difficulty of measuring the extent to which adaptation reduces underlying physical risks, which in turn hinders the ability of financial institutions and supervisors to comprehensively assess exposure to climate-related impacts. Assessing adaptation involves unique challenges that do not apply to mitigation. Adaptation actions can be highly location-specific, and there are limited quantitative adaptation policy targets (unlike the Paris Agreement for mitigation) with which institutions can align. Therefore, to date, adaptation finance has been constrained by two key challenges: the insufficient pipeline of bankable adaptation projects in some jurisdictions and the fact that adaptation projects generate returns over longer periods or yield broader benefits to a wider set of stakeholders that are harder to monetise by the funder. Adaptation projects often face difficulties in attracting private capital because their benefits materialize through avoided future damages, enhanced resilience and positive externalities that are not fully reflected in conventional financial assessments (UNEP, 2024). As a result, financing for adaptation investments remains limited. In emerging markets and developing economies alone – where exposure to physical risks is highest – annual adaptation finance flows cover only one-third of the required amount through 2030, with 92% of global adaptation finance coming from public sources. This reflects a combination of structural barriers, including lack of stakeholder capacities and underdeveloped enabling environments (e.g., capital markets, risk-sharing mechanisms, sound development policies).

5.1.3 Pillar 3

Pillar 3 promotes transparency towards supervisors and market participants, both for the banking and the insurance sector.[23] Climate-related disclosures, including information on exposures, risk management practices and the potential financial impact of climate change, contribute to this objective by enabling supervisors to better assess financial institutions' resilience to climate-related risks. In recent years, climate-related risks have become an increasingly important component of Pillar 3 disclosures. Consistent with emerging supervisory frameworks, and in some jurisdictions drawing on the BCBS voluntary framework for climate-related disclosures (BCBS, 2025), banks are increasingly providing information on their governance, risk management practices, strategy, exposures and key metrics related to climate-related risks. The framework aims to enhance market discipline and improve stakeholders' understanding of banks' exposure to climate-related financial risks through a consistent set of qualitative and quantitative disclosures. The BCBS stresses that climate data and methodologies remain evolving, which justifies retaining flexibility and a voluntary approach. Such disclosures enable investors, counterparties, and supervisors to better assess a bank's vulnerability to physical and transition risks. For insurers, the IAIS notes that 'supervisors should require that climate-related risks are effectively captured in public disclosure requirements, where material' (IAIS, 2025a) (Chapter 4).

As climate-related disclosure regimes mature and technology advances, supervisors may use disclosed information as an additional input into risk-based supervision. Disclosures may support peer benchmarking of climate risk maturity, identification of outliers and targeted supervisory engagement across financial entities. AI-enabled approaches may further assist supervisors to extract, structure and compare climate-related information from public disclosures at scale, as demonstrated by initiatives such as the **Bank of International Settlements'** Project Gaia for enabling climate risk analysis using Generative AI (BIS, 2024). Such approaches may help enhance supervisory monitoring while reducing additional reporting burden, but may be supported by appropriate human review, quality assurance, traceability and model governance. Disclosed information should remain complementary to, rather than a substitute for, supervisory data collections, prudential assessments and supervisory judgement.

23 It requires banks and insurers to provide regular regulatory reporting and to disclose relevant information on their financial condition, risk exposure and solvency position. By improving the availability and quality of information, this Pillar supports effective supervisory oversight, strengthens market discipline and enhances confidence in the banking and insurance sector.

5.1.4 Integration of nature-related risks in the micro-prudential framework

Nature-related risks are not currently subject to explicit Pillar 1 capital requirements. While nature-related factors may indirectly influence Pillar 1 calculations through their impact on traditional risk drivers (for example, through increased default risk of borrowers exposed to water stress or biodiversity loss) the existing framework does not specifically calibrate capital requirements for such risks. This reflects the current challenges associated with data availability, methodological development, and the quantification of nature-related risk impacts.

Pillar 2 currently represents the primary prudential mechanism through which nature-related risks could be addressed. Supervisory authorities increasingly expect institutions to identify, assess, monitor, and manage nature-related risks, where these are material to their business model and risk profile. Banks are expected to integrate these risks into their governance arrangements, risk management frameworks, ICAAP, and stress-testing exercises. Where supervisors may identify material vulnerabilities or deficiencies in risk management practices, they may require remediation measures and, where justified, impose additional capital requirements under Pillar 2.

Nature-related risks are also increasingly relevant under Pillar 3 through ESG disclosure requirements. While existing disclosure frameworks have primarily focused on climate-related risks, regulatory guidance is gradually expanding to encompass broader nature-related risks, including biodiversity and ecosystem-related risks. For example, the European Banking Authority Implementing Technical Standards (ITS) on Pillar 3 ESG disclosures require institutions to disclose qualitative information on the management of environmental risks including those beyond climate. Some supervisors consider integrating information on nature-related risks within supervisory reporting requirements such as gathering information on exposures and concentrations in environmentally sensitive sectors. Other supervisors also encourage institutions to align disclosures with international frameworks such as the TNFD, particularly regarding biodiversity-related dependencies, impacts, risks, and opportunities. Enhanced disclosures support market discipline by enabling investors, counterparties, and other stakeholders to better assess institutions' exposure and resilience to these emerging risk factors.

5.2 Micro-prudential tools

5.2.1 Thematic reviews conducted by supervisors

Thematic reviews on climate and nature-related risks have become an important micro-prudential tool for assessing institutions' preparedness. Unlike institution-specific supervisory assessments, thematic reviews enable supervisors to evaluate practices across a broad sample of firms and identify common weaknesses. For example, the **ECB**'s 2022 thematic review was designed as a deep dive into banks' ability to manage climate and nature risks and aimed to foster alignment with supervisory guidance. Following the thematic review, the ECB published in 2022 a compendium on the good practices observed to share illustrative examples and support banks in progressing towards supervisory guidance (ECB, 2022). The compendium was updated in 2026, when good practices for both climate and nature risk management (ECB, 2026a) and stress testing (ECB, 2026b) were published.

Such thematic reviews can provide supervisors with a basis for future supervisory actions. The results from the review can feed directly into core processes such as the SRP or on-site inspections. The ECB has progressively linked the findings of climate risk-related reviews to concrete supervisory measures, including legally binding requirements like periodic penalty payments.[24] The French **Autorité de Contrôle et de Résolution** also integrates climate-related risks into some on-site inspections and uses review results to issue tailored recommendations. For the smaller banks and specialized firms under its direct supervision, the French supervisor has used questionnaires inspired by the ECB approach. In 2023, it covered a representative sample of 58 institutions and expanded it to 90 institutions in 2024, with both a standard questionnaire and a simplified version for newly in-scope entities. Thematic reviews

24 https://www.bankingsupervision.europa.eu/about/banking-supervision-explained/html/periodic_penalty_payments.en.html.

thus serve as a bridge between diagnostic work and supervisory action (South African Reserve Bank, 2025).

While dedicated thematic reviews focusing exclusively on nature-related risks remain very limited, supervisory authorities could progressively build on existing climate and nature supervisory programmes by expanding their scope to explicitly incorporate nature-related risks. In particular, the methodologies, governance assessments, risk management reviews and portfolio analyses developed for climate thematic reviews could be adapted to assess institutions' dependencies and impacts on ecosystem services, exposure to sectors vulnerable to nature degradation, and the integration of nature-related risks into risk management frameworks (BCBS, 2025).

5.2.2 Transition plans

Although transition plans are not a prudential tool as such for most supervisors, they can support micro-prudential supervision. From a supervisory perspective, transition plans offer insights into the climate-related risks associated with an institution's strategic choices, often over a longer time horizon than that typically captured by traditional prudential tools. These plans can provide a structured view of an institution's climate-related ambitions, implementation of pathways, and key assumptions. They also provide insights into how institutions identify, manage and mitigate climate-related risks, adapt their business models and strategies, and strengthen their resilience to the transition towards a more sustainable economy. The prudential treatment of transition plans varies across jurisdictions. In some cases, transition plans form part of sustainability-related disclosure requirements and are not directly embedded in prudential frameworks; in others, their publication remains voluntary.

Transition plans can also be required by banking regulation. For example, banks in the European Union are required to develop prudential transition plans under Article 76 of the Capital Requirements Directive (CRD). These requirements are further specified in the **European Banking Authority** Guidelines on ESG Risk Management, which place prudential transition plans within the broader framework of ESG risk management (EBA, 2026). The plans should be consistent with the institution's overall business strategy and risk management framework and should clearly define roles, responsibilities, governance arrangements, and internal processes, including procedures for the regular review and updating of the plans. The objective of these plans is to enable institutions to identify, manage, and monitor the risks arising from the transition to a more sustainable economy without prescribing one uniform climate pathway or business strategy.

The NGFS has highlighted that transition plans could adopt a holistic perspective, integrating not only climate transition and physical risks but also nature-related risks (NGFS, 2026a). In practice, this could involve assessing how institutions identify and manage exposures to sectors that depend on ecosystem services, setting objectives to reduce nature-related vulnerabilities, and incorporating nature considerations into governance, risk management and strategic planning processes. The development of nature-related transition planning would also help institutions take a forward-looking approach to emerging risks associated with ecosystem degradation and nature-related transition policies. Over time, expanding transition plans in this way could help support a more integrated management of climate and nature-related risks, reflecting the strong interdependencies between climate change, biodiversity loss and long-term financial stability.

Technical box 7

NGFS work on transition plans

The NGFS has developed a body of work on transition plans, moving from an assessment of emerging practices to more practical guidance for supervisors and financial institutions. This work recognises transition plans as a potentially important tool for supporting the transition to a net-zero economy, mobilising capital, and managing climate-related risks.

The first milestone was the 2023 Stocktake on Financial Institutions' Transition Plans and their Relevance to Micro-prudential Authorities (NGFS, 2023a). It reviewed existing transition plan frameworks and supervisory practices across jurisdictions. The stocktake highlighted the diversity of definitions and approaches, distinguishing between transition planning as an internal strategic process and transition plans as the resulting outputs or disclosures. It concluded that transition plans could provide useful information to supervisors, particularly in assessing whether an institution's transition strategy is consistent with its risk management framework and overall safety and soundness. The report also identified common elements across transition plan frameworks and explored how transition plans could be incorporated into existing supervisory toolkits.

Building on this work, the NGFS published its Transition Plan Package in 2024, covering cross-cutting topics (NGFS, 2024d). It explores the specific challenges faced by emerging market and developing economies (EMDEs), analyses the links between the transition plans of financial and non-financial firms, and assesses the credibility of financial institutions' transition plans from a micro-prudential perspective. Across these reports, the NGFS emphasises the need for coherent international guidance, holistic approaches that consider both transition and physical risks, and stronger links between transition planning, governance and risk management.

The NGFS has supplemented this work in 2025 with analytical notes aimed at supporting the operationalisation of these plans by financial institutions and their assessment by supervisors (NGFS, 2025d; NGFS, 2025e). The note on Target Setting and Transition Plans examines the role of climate-related targets as a key feature of credible transition plans. It provides considerations for supervisors assessing their robustness, governance, implementation and monitoring. It highlights that well-designed targets can support risk management, strategic planning and accountability, while weak or poorly monitored targets may undermine the credibility of transition plans. The NGFS has also published work on Climate Scenario Analysis and Transition Plans, highlighting the complementary relationship between the two as forward-looking tools. While scenario analysis helps institutions assess resilience under different climate pathways, transition plans describe the strategic actions intended to navigate those risks and opportunities. Together, they strengthen the forward-looking dimension of prudential supervision by helping institutions and supervisors assess the plausibility, resilience and credibility of transition strategies under a range of future climate outcomes.

5.3 Macro-prudential framework and tools

The macro-prudential framework for climate-related risks can be structured around three complementary pillars: (i) risk identification and monitoring, (ii) vulnerability assessment through scenario analysis and stress testing, and (iii) policy and regulatory responses to enhance resilience. First, risk surveillance aims to monitor the evolution of climate-related hazards and the exposure of the financial system to physical and transition risks. This includes tracking indicators such as carbon-intensive exposures, geographic exposure to natural hazards, and sectoral vulnerabilities. Second, vulnerability assessment relies on climate scenario analysis and stress testing to evaluate how climate shocks may affect the financial system. This Pillar helps identify potential amplification mechanisms, including asset repricing, credit losses, and contagion effects. Third, policy intervention focuses on mitigating identified systemic risks through macro-prudential tools and supervisory action. Potential measures include systemic risk buffers, concentration

limits, sectoral capital requirements, and other instruments designed to enhance the resilience of the financial system and prevent the build-up of climate-related vulnerabilities. Macro-prudential tools for the supervision of climate-related financial risks remain, at this stage, exploratory and only limitedly developed by supervisory authorities. Accordingly, this section highlights possible future uses of these tools, rather than describing well-established practices currently implemented by supervisors. Nevertheless, some preliminary initiatives have been observed among some authorities and are referenced throughout this section.

5.3.1 Risk identification and monitoring

Macro-prudential monitoring indicators play an important role in identifying climate-related vulnerabilities across the financial system. Given that climate and nature-related risks may materialise simultaneously across sectors, jurisdictions and institutions, supervisors may monitor system-wide indicators to assess how climate-related shocks are transmitted and amplified through the financial system, consistent with the FSB's analytical framework for climate-related vulnerabilities (FSB, 2025). Examples include aggregate credit losses, repricing of carbon-intensive assets, insurance losses linked to physical hazards, liquidity pressures arising from abrupt market adjustments, and cross-border spillovers from exposures to climate-vulnerable sectors or regions. These indicators can support the early identification of systemic vulnerabilities and strengthen authorities' ability to assess climate-related risks to financial stability.

Supervisors are encouraged to monitor the insurance protection gap as part of their macro-prudential surveillance framework, given its potential implications for financial stability. By leaving a larger share of losses uninsured, protection gaps may weaken the balance sheets of households and corporates, impair asset quality in the banking sector and increase fiscal pressures through post-disaster public support measures. Over time, these dynamics can amplify the macro-financial impacts of climate shocks and contribute to the transmission of risk across sectors of the financial system. Recent IAIS analysis (IAIS, 2025b) highlights the potential for widening natural catastrophe protection gaps to shift risk from insurers towards banks and sovereigns, while the FSB's climate vulnerability framework identifies such cross-sectoral transmission and amplification channels as key mechanisms through which climate-related shocks may threaten financial stability (FSB, 2025). Monitoring insurance protection gaps can provide valuable insights into the resilience of the financial system to climate-related physical risks. Authorities may track indicators such as insurance penetration, the share of uninsured losses, insurance affordability and availability, and the concentration of underinsured exposures in climate-vulnerable sectors and regions. Monitoring the transmission of uninsured losses to bank balance sheets, credit markets and public finances can help identify emerging vulnerabilities and assess whether physical risks are being redistributed towards parts of the financial system less able to absorb them. Such metrics may therefore complement broader climate-related vulnerability assessments and support the early detection of systemic risk arising from physical climate hazards.

5.3.2 Vulnerability assessment through climate scenario analysis

Climate scenario analysis can serve as important tools by assessing the resilience of the financial system as a whole. Unlike micro-prudential exercises, macro-prudential climate analysis focus on identifying system-wide vulnerabilities, common exposures, risk concentrations and potential transmission channels across the financial sector. Their core purpose is not to determine the capital needs of individual institutions, but rather to enhance authorities' understanding of how climate-related shocks may affect financial stability under different scenarios and over varying time horizons. While short to medium-term micro-prudential stress tests typically rely on a static balance sheet assumption, long-term macro-prudential climate scenario analyses often require dynamic balance sheet approaches. Over multi-decade horizons, dynamic assumptions can better capture how financial institutions adjust their business models, rebalance portfolios and reduce exposures to carbon-intensive sectors in response to the transition. Macro-prudential climate scenario analysis seeks to assess not only forward-looking losses but also the amplification mechanisms through which climate-related shocks may affect financial stability. However, a key modelling gap remains the treatment of macro-financial feedback loops and second-round effects. Current frameworks have limited ability to capture how the simultaneous actions of financial institutions, such as rapid deleveraging or a collective tightening of credit to carbon-intensive sectors, could weaken economic activity and subsequently feed back into higher losses across the financial system.

Climate stress tests can support the monitoring of emerging systemic risks, inform macro-prudential surveillance and contribute to the design of appropriate policy responses aimed at strengthening the resilience of the financial system. The ECB's economy-wide climate stress tests conducted in 2021 and 2023 illustrate how system-wide scenario analysis can be used to assess the implications of different climate transition pathways and physical risk outcomes for the broader economy and the banking system. Another example is the **Central Bank of Egypt**, which integrates climate change risks into its macro-prudential risk assessment primarily through scenario-based stress testing exercises. Within the supervisory framework, climate change is explicitly treated as a source of systemic risk, and forward-looking stress test scenarios are designed to assess the potential impact of climate-related shocks on the solvency and liquidity of financial institutions. Climate stress testing scenarios incorporate transition and physical risk channels and are conducted with graded levels of severity. The exercises evaluate the exposure of the banking sector to climate-sensitive economic sectors and the transmission of climate-related shocks across the financial system. In particular, the framework provides evidence on the sectors most vulnerable to physical risks and assesses the potential impact on the real economy; while also identifying sectors most exposed to transition risks arising from policy, technological and market adjustments associated with the low carbon transition. Consistent with this sectoral analysis, the stress testing exercise places a specific focus on banking risks resulting from both physical and transition risks, examining how climate-related shocks may materialize through credit, market and liquidity risk channels and affect banks' balance sheets and resilience.

In the longer term, macro-prudential climate scenario analysis could be progressively expanded to incorporate nature-related risks, leveraging many of the methodologies already used for climate risk assessments. From a macro-prudential perspective, these exercises could identify system-wide vulnerabilities arising from common exposures, sectoral concentrations and cross-border interconnections. Climate scenarios could therefore be broadened to capture biodiversity loss, ecosystem degradation and nature-related transition policies, reflecting the close interdependencies between climate and nature and their potential implications for financial stability. Alternatively, supervisors could develop macro-prudential stress test scenarios covering direct systemic physical and/or transition channels. Physical risk scenarios may assess how material ecosystem service disruptions such as water scarcity, biodiversity loss or soil degradation disrupt economic activity and increase credit losses; while transition scenarios may examine how abrupt restrictions on biodiversity-harming activities trigger asset repricing, supply chain disruptions and losses across financial institutions' portfolios. Such scenarios could assess how shocks to nature-dependent sectors propagate through the financial system *via* higher default rates, asset repricing, insurance losses and reductions in collateral values. Attention could be paid to amplification mechanisms, including common exposures across financial institutions, feedback loops between the real economy and the financial sector, and potential cross-border spillovers. These exercises would go further than current nature-related assessments (see 3.4.3) and would help identify pockets of risks at the level of individual institutions and systemically relevant nature-related vulnerabilities and support financial stability surveillance. This would require, however, an improvement of scenario modelling tools, to make them fit-for-purpose for full-fledged nature scenarios (NGFS, 2023d and NGFS, 2026d).

5.3.3 Policy and regulatory responses to enhance resilience

Systemic buffers

Macro-prudential authorities can enhance the resilience of the financial system through climate systemic risk buffers that require banks with material exposures to climate-sensitive sectors or regions to hold additional capital. For example, supervisors could apply a buffer to banks whose lending to high-emitting sectors exceeds a specified threshold, reflecting the risk that an abrupt policy transition or rapid repricing of carbon-intensive assets could generate simultaneous losses across multiple institutions. Similarly, additional capital requirements could be applied to banks with concentrated exposures to regions highly vulnerable to physical climate hazards. For instance, banks with large mortgage portfolios in areas subject to recurrent flooding could be required to hold higher capital buffers to account for the potential for correlated losses following severe climate events. Such measures could strengthen the resilience of the banking system to both transition and physical climate risks (ECB-ESRB, 2023).

Another potential category of macro-prudential measures consists of borrower-based tools that differentiate lending conditions according to predefined environmental characteristics. Under this approach, authorities may consider adjusting loan-to-value (LTV) limits or down-payment requirements for certain green assets, such as energy-efficient buildings or low-emission vehicles. More favourable financing conditions could include higher LTV ratios, full financing for certified green buildings, or reduced minimum down-payment requirements, subject to institutions' internal risk assessments and sound risk management practices. Such measures would be intended to reflect potential differences in risk profiles and resilience characteristics while supporting financial stability objectives. Their use within a macro-prudential framework would nevertheless depend on ensuring that asset quality remains robust and that prudential standards are maintained. Another borrower-based approach maintains LTV limits but allows additional borrowing where the incremental financing is exclusively dedicated to energy-efficiency improvements. Under this model, the additional funds must be used for measures such as insulation, heat pumps or renewable energy installations. A related approach consists of incorporating expected reductions in energy expenditures into affordability assessments, thereby allowing higher borrowing capacity for households purchasing or occupying more energy-efficient dwellings. Unlike differentiated LTV requirements, these approaches do not primarily rely on an assumption of lower underlying credit risk. Instead, they are based on the expectation that lower energy costs improve borrowers' debt-servicing capacity and financial resilience over time. Borrower-based measures (BBMs) could also be used to mitigate climate-related risks by addressing the build-up of vulnerabilities in particularly exposed segments of the market. For example, authorities could apply more stringent LTV limits to mortgage lending in areas highly exposed to physical climate hazards, such as recurrent flooding or wildfires.

To enhance the effectiveness of borrower-based measures, authorities can embed them within a broader policy package that supports energy-efficiency improvements through complementary fiscal incentives, administrative simplification, and public outreach. Public information campaigns can help households assess the financial viability of renovation projects and raise awareness of available financing and subsidy schemes. In addition, the calibration of borrower-based measures should be reviewed regularly to reflect advances in energy-efficiency standards, renovation practices, and methodological improvements (CETEx-LSE, 2026b).

Temporary relief measures

Some supervisors have established temporary regulatory and supervisory measures to respond to acute climate-related events. These interventions are designed to mitigate immediate pressures on borrowers and financial institutions while supporting the stability of the financial system. Typically activated following the official declaration of an emergency or disaster, such measures are generally temporary, proportionate and implemented within existing prudential frameworks. Supervisors can encourage financial institutions to work constructively with affected borrowers. These measures may include grace periods for principal and interest payments, repayment deferrals aligned with sector-specific recovery periods, or the restructuring of credit exposures without an automatic deterioration in prudential classification. Such measures are generally limited to borrowers that were performing prior to the event and remain subject to institutions' assessments of borrowers' post-event viability. For example, following Hurricane Harvey (2017) and Hurricane Helene (2024) in the United States, banking supervisors encouraged banks to offer repayment relief and loan modifications to borrowers affected by the disasters. Governments may complement these measures through financial support programmes aimed at restoring borrowers' repayment capacity and accelerating recovery. Following Cyclone Gabrielle in New Zealand (2023), the government introduced regulatory exemptions to facilitate emergency lending and provided recovery support to affected communities, while banks offered low-cost lending, repayment relief and emergency credit facilities. Similarly, following the 2022 floods in Queensland and New South Wales (Australia), government recovery efforts were complemented by banking sector initiatives, including repayment deferrals, loan restructuring and emergency financing for affected households and businesses. Together, such measures can help alleviate short-term financial distress, reduce the risk of unnecessary defaults and support the orderly functioning of the financial system during the recovery phase.

The objective is to alleviate short-term liquidity pressures, avoid unnecessary defaults and limit procyclical effects on credit provision during the recovery phase. Supervisors may also introduce temporary prudential accommodations for affected exposures. These can include, for supervisory purposes, the temporary exclusion of certain loans from past-due or non-performing loan metrics, as well as flexibility regarding the timing of loss recognition and provisioning. For example, banks may be permitted to phase in credit loss allowances or impairment charges over time, subject to supervisory approval and continued compliance with sound risk management practices. Such measures seek to preserve the relevance of prudential indicators while avoiding abrupt and mechanically driven impacts on institutions' capital positions following a severe climate-related event. These interventions are generally accompanied by strict supervisory safeguards. Institutions are typically required to notify supervisors of their use of relief measures, document their scope and duration, and maintain appropriate records for supervisory review. In addition, temporary relief frameworks commonly include clear exit and transition arrangements, requiring institutions to establish plans for returning to normal prudential requirements and to strengthen business continuity, disaster recovery and contingency funding capabilities.

From a broader financial stability perspective, these measures illustrate how supervisory and macro-prudential policies can complement traditional micro-prudential supervision in responding to climate-related emergencies. While micro-prudential supervision focuses on the resilience of individual institutions, temporary system-wide relief measures can help contain the broader economic and financial consequences of climate-related shocks, thereby limiting spillovers to the financial system. When carefully designed, targeted and time-bound – and while considering risks such as weakened credit discipline, loan evergreening or moral hazard – these measures can support financial stability and facilitate recovery while remaining consistent with the objectives of risk-based prudential supervision.

5.4 Other supporting tools: taxonomies

Climate taxonomies can support the implementation of prudential and macro-prudential tools by providing a common and consistent framework for classifying climate-related exposures. Although they are not always developed by supervisors themselves and may originate from governments, regulators or other public authorities, taxonomies provide a common classification framework for identifying economic activities based on environmental objectives and sustainability criteria. By improving the identification, measurement and comparability of climate and nature-related risks across financial institutions, taxonomies may enhance the effectiveness of supervisory risk assessments, climate scenario analysis and stress testing exercises. They may also support the monitoring of systemic climate-related vulnerabilities and inform the design and calibration of potential macro-prudential measures aimed at strengthening financial system resilience. For example, macro-prudential tools targeting carbon-intensive sectors require consistent definitions of the activities and sectors concerned, while disclosure, reporting and risk-monitoring requirements depend on agreed classifications of green, transition and high-emitting activities. Taxonomies can also support concentration analyses and the assessment of financial institutions' exposures to sectors vulnerable to transition or physical risks by providing a common basis for data aggregation and comparison.

While taxonomies are not risk assessment tools in themselves and do not provide a direct measure of financial risk, they can enhance the effectiveness of prudential frameworks by providing a common reference point for the identification and analysis of climate and nature-related exposures. Their usefulness for prudential purposes ultimately depends on their scope, level of granularity, scientific robustness and alignment with the objectives of financial supervision. The following section highlights recent developments in green taxonomies across selected jurisdictions.

Case study 5.3: Latest developments in taxonomy	
Uganda	In Uganda, the National Green Taxonomy was developed in 2025 by the Ministry of Finance, Planning and Economic Development (MoFPED) in partnership with the Ministry of Water and Environment (MWE), with support from several international development partners. The taxonomy establishes a clear framework to identify environmentally sustainable economic activities and to channel public and private finance toward green investments. The framework is structured around six environmental objectives: climate change mitigation, climate change adaptation, sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control, and protection and restoration of biodiversity and ecosystems. Activities qualify when they (i) make a substantial contribution to at least one environmental objective, (ii) do no significant harm (DNSH) to the remaining objectives, and (iii) comply with minimum social safeguards (Government of Uganda, 2025). The taxonomy defines technical screening criteria across key sectors, including forestry, agriculture, renewable energy, construction, and waste and water management. Eligible activities must meet sector-specific thresholds.
Brazil	In 2025, the Brazilian Federal Government launched the Brazilian Sustainable Taxonomy (TSB) as part of the Ecological Transformation Plan, establishing a unified framework to identify economic activities and projects that contribute to the country's climate, environmental, and socio-economic objectives. The **Banco Central do Brasil** actively participated in the development of the TSB. It aims to mobilize capital toward activities that generate positive climate, environmental, and social impacts; foster sustainability-oriented technological innovation; and provide a reliable basis for tracking financial flows directed to sustainable activities. The taxonomy covers strategic sectors of the Brazilian economy, including agriculture, livestock, energy, extractive industries, manufacturing, water and sanitation, waste management, construction, transportation, and social services, with detailed criteria at the economic activity level. The TSB relies on science-based technical screening criteria and requires sustainable activities to comply with the principles of Substantial Contribution, Do No Significant Harm (DNSH), and Minimum Safeguards, while incorporating Brazil-specific social and territorial priorities. The TSB is a dynamic tool and in its first edition prioritizes climate change mitigation and adaptation, as well as the reduction of socio-economic inequalities related to race and gender, while also incorporating transition and enabling activities. The TSB is grounded in a broad set of legal frameworks, including, among others, strategies and commitments undertaken by Brazil at the national and international level, such as its Nationally Determined Contribution (NDC), the Sustainable Development Goals (SDGs) of the 2030 Agenda, and the Climate Plan developed by the Ministry of Environment and Climate Change (MMA). The TSB is aligned with the Principles for Taxonomy Interoperability, while remaining anchored in Brazil's structural conditions and national priorities. Its governance framework – comprising an interinstitutional committee, supervisory and technical working groups, and an advisory committee – supports periodic updates, public consultations, and methodological consistency over time. …/…

Malaysia	Malaysia's Climate Change and Principle-based Taxonomy (CCPT), issued in 2021 by **Bank Negara Malaysia**, establishes a principles-driven framework to assess and classify economic activities according to their contribution to climate change mitigation and adaptation, while supporting an orderly transition of the economy. The taxonomy is designed primarily for financial institutions and enables consistent assessment, classification, and reporting of climate-related exposures and financing. The CCPT is structured around five guiding principles. Activities must contribute to climate change mitigation (GP1) and/or climate change adaptation (GP2), both assessed at the transaction level. At the entity level, activities are assessed against No Significant Harm to the environment (GP3), the adequacy of remedial measures to address harm identified in GP3, and compliance with environmental and social legislation in relation to the performance of prohibited activities (GP5). Based on these principles, activities are classified into a tiered system – ranging from Climate Supporting to Transitioning and Watchlist categories – reflecting both their current climate contribution and the credibility of transition efforts. The taxonomy explicitly recognises transition activities and remediation pathways in order to avoid disruptive exclusions.
China	In 2025, the **People's Bank of China**, together with relevant financial regulatory authorities, revised and issued the *Green Finance Support Project Catalogue (2025 Edition)*. This unified catalogue is applicable to various green financial products and further refines the identification standards for green activities. It includes a dedicated 'Ecological Protection and Restoration' section, which encompasses 13 activities such as biodiversity conservation, the construction and protective operation of protected areas, wetland protection and restoration, and marine ecology, coastal zone, and island ecological restoration. This provides a unified basis for green finance to identify and support ecological protection and restoration projects. Concurrently, the People's Bank of China organized the development of the *Biodiversity Finance Catalogue (Trial Draft)*, one of the few globally independent, dedicated biodiversity finance standards. Adhering to core principles such as 'Do No Significant Harm,' 'Substantial Contribution,' 'Prudent Use,' 'Coordination and Consistency,' and 'Risk Prevention,' the catalogue covers four major areas: Sustainable Use of Biological and Natural Resources; Biodiversity and Ecosystem Conservation and Restoration; Nature-based Solutions (NbS); and Biodiversity-Friendly Activities in High-Sensitivity Sectors. It defines 87 biodiversity-related activities and their criteria, specifying the basic requirements for related financial support activities. Currently, the standard is being piloted on a large scale across the country, with over 1,700 financial institutions participating. …/…

European Union	In 2020, the **European Union** adopted Regulation (EU) 2020/852, establishing a common framework to determine whether an economic activity can be considered environmentally sustainable. The Regulation provides a unified classification system to support sustainable finance, enhance transparency, and align capital allocation with the Union's climate and environmental objectives. Under the Regulation, an economic activity qualifies where it substantially contributes to at least one of six environmental objectives: climate change mitigation, climate change adaptation, sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control, protection and restoration of biodiversity and ecosystems. While contributing substantially to one of the objectives, it shall do no significant harm to any other of the objectives. Furthermore, the activity needs to comply with minimum social safeguards such as no forced labour or child labour. Alignment is defined through science-based technical screening criteria, established in delegated acts and designed to ensure comparability, credibility, and robustness across sectors. In addition to activities that are already environmentally sustainable, the framework recognizes transition and enabling activities that support the shift toward a low-carbon and climate-resilient economy where no feasible alternatives currently exist. The EU Taxonomy underpins sustainability related disclosures, financial supervision, and risk assessment, and serves as a reference point for the EU's sustainable finance framework. It is subject to periodic updates to reflect technological progress, evolving policy objectives, and scientific evidence.

6. Looking forward

The practices and case study presented in this Guide demonstrate that the integration of climate and nature-related risks into supervision has advanced significantly across jurisdictions since the previous version in 2020. Supervisors are increasingly embedding these risks into their core supervisory frameworks and processes.

Going forward, continued progress will require sustained capacity building, stronger international cooperation, and further support from regulators and standard setters to ensure supervisory approaches remain consistent, proportionate, and effective.

Building on the findings of this Guide, **the NGFS intends to continue advancing work in the following areas:**

- **Supporting effective integration into supervisory processes.** The NGFS will continue to identify, update, and promote supervisory good practices and capacity building to help jurisdictions integrate climate and nature-related risks into risk assessments, scenario analysis, and other supervisory processes.
- **Improving data and methodologies.** The NGFS will continue to support the development of more granular, standardised, and forward-looking data, metrics, and analytical approaches to strengthen supervisory assessments, including addressing data and methodological gaps. Continued collaboration with financial institutions, data providers, academia, and international organisations will be critical to improving methodologies, disclosures, and supervisory reporting.
- **Advancing integrated climate and nature risk analysis.** The integration of nature-related risks into supervisory frameworks is expected to build progressively on existing climate risk approaches while recognising the financial system's dependence on ecosystem services and natural capital. The NGFS will further develop approaches to assess the interactions between climate and nature-related risks, including blended climate-nature scenarios.
- **Integrating adaptation and mitigation.** The NGFS will explore potential avenues for further integrating adaptation and mitigation considerations into supervisory frameworks, thereby supporting long-term financial stability.
- **Strengthening supervisory responses to emerging risks.** As supervisory guidance evolves, the NGFS will continue to explore approaches for assessing emerging sources of financial risk, including climate and nature-related litigation, legal and reputational risks.
- **Promoting the prudent use of supervisory frameworks.** The NGFS will continue to support the development of supervisory approaches that make effective use of existing prudential frameworks, including micro- and macro-prudential tools, while contributing to international discussions on the appropriate and evidence-based use of prudential policy tools to address climate and nature-related risks.

The NGFS will continue to promote international cooperation and knowledge sharing to support a globally consistent approach to climate and nature-related risk supervision. As supervisory practices, data, and methodologies mature, collaboration with international standard setters will remain important to support the continued development of regulatory and supervisory frameworks that preserve financial stability while supporting an orderly transition to a resilient and sustainable economy.

7. Annexes

Annex A: List of useful material to be collected from institutions by supervisors

Supervisors may need to tailor these questions to the institutions and their own jurisdiction, taking into account factors such as size and complexity.

General information and familiarity of the institution with climate and nature-related risks

1. Did your financial institution perform a materiality assessment of climate and nature-related risks, and how?
2. What is your perception of potential threats/opportunities to your financial institution?
3. Is your financial institution considering your response to key national or international policy initiatives in this area and their impact on the institution?

Strategy and governance

1. Has your board determined how to effectively integrate climate and nature considerations into the board committee structures?
2. What processes are in place to inform the board (and relevant committees) about climate and nature-related risks? What is the frequency of such inputs?
3. How does your board ensure that climate and nature considerations are given sufficient attention across the financial institution (e.g., being discussed in the audit, risk, nomination or remuneration committees?)
4. Are climate and nature considerations incorporated into strategic planning, business models, financial planning and other decision-making processes?
5. Does your corporate strategy include a holistic climate strategy informed by scenario analysis, that is climate risk mitigation and adaptation as well as business continuity and opportunities?
6. What are the key climate and nature drivers that you would consider relevant to your strategy?
7. How climate and nature-related considerations are integrated into client engagement, stewardship, lending and/or underwriting practices?

Risk management, scenario analysis and disclosure

1. How is your financial institution incorporating climate and nature-related risks within your risk management framework?
2. Does your financial institution expect that physical risks will affect business performance across different business lines, through impacts on customers, claims or values of assets or collateral? If yes, please explain how, and over what timeframes. If no, please explain why not. How do you expect these risks to materialise over the short, medium, and long term?
3. Does your financial institution expect that transition risks will affect business performance across different business lines, in terms of market demand, impacts on customers, values of assets/collateral or other factors? If yes, please explain how, and over what timeframes.
4. Does your financial institution expect that liability risks will affect business performance across different business lines, in terms of market demand, impacts on customers, values of assets/collateral or other factors? If yes, please explain how, and over what timeframes.
5. How does your financial institution perceive the potential for reputational risks arising from your investment or underwriting decisions in climate-related sectors (that is high carbon assets)?

.../...

6. Are different climate scenarios being used to inform the assessment of climate change materiality at your financial institution? What types of scenarios is your financial institution seeking to apply? What are the data inputs and key assumptions applied? Are climate scenarios conducted in such a way that the results can be used to inform the company's or board's response to climate issues? What types of gaps and barriers (information, data, scenarios) might complicate your efforts to undertake scenario analysis?
7. Has your financial institution quantified nature-related risks beyond climate change or assessed the underlying nature-related dependencies and impact on ecosystem services, and how? How are the results taken into account in your financial institutions' risk monitoring and management framework?
8. Does your financial institution publicly disclose information on the material financial risks and opportunities associated with climate change and nature degradation? If yes, what type of information is disclosed (institution strategy, processes for identifying, assessing, and managing climate and nature-related risks, exposures, impact, metrics; qualitative information only or also quantitative)
9. What are the key challenges that your financial institution has faced in your efforts to enhance disclosure of information relating to climate and nature-related factors?

List of documents and data sets that may be requested by supervisors

The following list includes a set of documents and data that supervisors may request from institutions as part of an off-site review of their compliance with supervised guidance. The list of documents aims to support proportional, risk-based supervision and to promote comparability across institutions. The list also provides clarity to supervised institutions regarding the type of evidence that may be required to demonstrate compliance, thereby enhancing transparency and reducing the administrative burden.

1. Governance & Internal Control
   - Organisational chart, governance framework, committee structures
   - Board or committee minutes and materials relevant to the supervisory guidance
   - Risk management framework, risk appetite, internal control descriptions
   - Internal audit and compliance reports related to the climate and nature risk management
   - Remuneration policies, integration of climate and nature considerations
   - Training policies and programmes

2. Policies, Procedures & Methodologies
   - All policies relevant to the supervisory guidance (e.g., credit risk, ESG, IT, data management)
   - Associated procedures, standards and methodological documents
   - Data management: gap analyses, implementation plans and internal decision memos

3. Risk Data, Reporting & Quantitative Information
   - Key risk indicators, dashboards and management reports
   - Portfolio breakdowns (e.g., by sector, geography, ESG metrics)
   - Stress test results, scenario analysis outputs

4. ICAAP/ILAAP & Strategic Documents
   - ICAAP and ILAAP reports, methodologies and assumptions
   - Business strategy documents relevant to risk management

.../...

5. Climate and Nature Risk
   - Sustainability/ESG/environmental/climate and nature risk management policies
   - Environmental risk scenario analysis & climate stress testing
   - Data sources, proxies and methodological documentation
   - Transition plan and monitoring reports

6. Audit, Incidents & Training Evidence
   - Internal/external audit findings and remediation status
   - Staff training records relevant to the supervisory guidance

The information outlined herein is not exhaustive and may need to be tailored to the institution's size, complexity, business model and risk profile. Supervisors may request additional documentation where necessary to clarify specific supervisory concerns or to gain further insight into the institution's practices.

Annex B: Overview of the sources of nature-related risks and their transmission to the economy

Intensification and materialisation of physical and transition risks

Since the publication of the NGFS Guide for Supervisors in 2020, evidence shows that the degradation of nature and climate change has continued to intensify. This suggests that supervisors may wish to strengthen their actions, given the implications for the financial system.

Examples of increased physical and transition risks since 2020 are presented in the table below. The materialisation of the risks presented in the table does not cover financial and economic impacts (addressed in Sections 1.3 and 1.4) but rather highlights the physical degradation of climate and nature, as well as transition-related actions.

Table B.1 **Illustration of the intensification of nature degradation, climate change and transition-related activities since 2020**

Type of event	Risk category	Examples
Rising temperature	Chronic physical risk (climate)	As of 2025, the climate already warmed by an average of 1.3 °C relative to the preindustrial average, with no reverse in trend (World Meteorological Organization, 2025). The year 2025 was regarded as one of the warmest years on record, with temperatures exceeding 1.5 °C above the preindustrial average (Coalition of Finance Ministers, 2025). The United Nation Environment Programme (UNEP) concluded that global temperatures will very likely exceed 1.5 °C when compared to industrial levels within the next decade (UNEP, 2025).
Extreme weather events	Acute physical risk (climate)	The frequency and intensity of extreme weather events are increasing (NGFS, 2026c). The number of registered extreme weather events rose from approximately 200 in 1980 to around 800 in 2018 (Munich Re, 2020), with an expanding range of geographic locations affected.[1] NASA data indicate a rise in the intensity of events such as droughts and floods over the past five years (The Guardian, 2025).
Biodiversity loss	Chronic physical risk (nature)	(WWF, 2024) reports an average 73% decline in monitored wildlife populations since 1970. This figure stood at 69% in the 2022 edition, highlighting the worsening biodiversity loss in recent years.
Policy and regulation	Transition risk (nature)	Many states are strengthening regulatory framework on pollution. For example, the European Union has decided to cut the allowed annual limit value for fine particulate matter, the main air pollutant, by more than half by 2030 (European Commission, 2024). Argentina adopted a law (Ley 27602) in 2020 banning the production, import, and marketing of personal care products containing added plastic microbeads.
Consumer preferences	Transition risk (climate)	Global electric car sales increased more than fivefold between 2020 and 2024, as reported by the International Energy Agency.[2]

1 While part of this increase is due to improved reporting of events, scientific research confirms that most of this increase is due to climate change (Qi Lui *et al.*, 2026).

2 A further possible variation in the use of terminologies is the differentiation between environmental and further nature-specific risks. Such a differentiation would mean that a distinction is made between environmental aspects such as pollution of land, water and air, and other so-called nature-specific aspects related to fauna and flora, such as loss of biodiversity, loss of ecosystem services, or threats through invasive species.

Transmission of climate and nature-related risks to the economy

Transition and physical risks are transmitted to the economy through both supply- and demand-side channels.

First, transmission through the supply side can operate by affecting both capital and labour. Productive capital can be damaged (e.g., by extreme weather events) or become unsuitable (e.g., corporate buildings not adapted to rising temperatures or sea level rise), reflecting the manifestation of physical risks. Transition risks may also have impacts. For example, they may force major participants – such as individual firms affected by new regulations – out of the market, notably due to increases in energy prices or leading to asset stranding (e.g., outdated energy supply

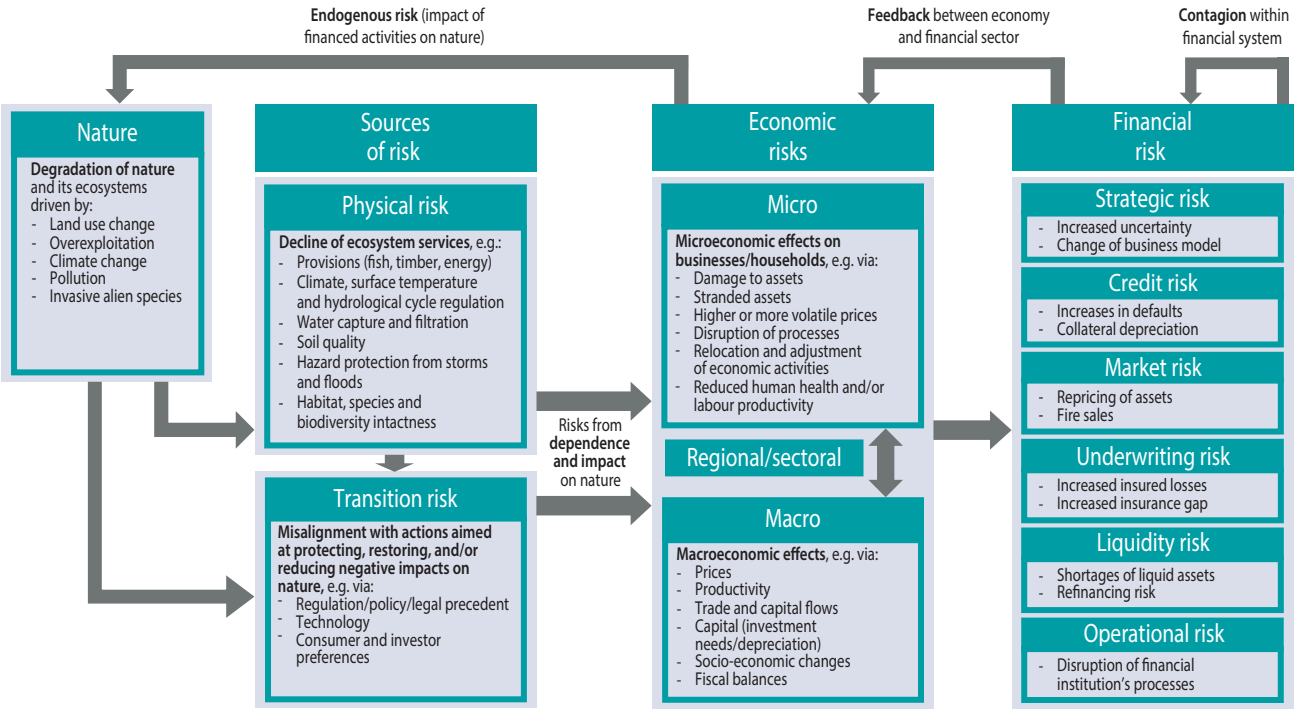
infrastructure).[1] Beyond capital, the labor supply can also become temporarily unavailable in case of a displacement of workers, or of a temporary shortage of skilled labour due to a need for training on new industries and technology) or less productive (e.g., pollution affecting workers' health) (World Health Organization, 2025).

Second, on the demand side, negative shocks and transmission can also be highlighted. Households may see their income and wealth impacted (e.g., devaluation of real estate located in flood-prone areas), leading to a decline in demand. Moreover, negative demand shocks may arise in sectors that are most exposed to physical risks (e.g., tourism) and transition risks (e.g., transport or energy).

These shocks can lead to both micro and macroeconomic impacts (NGFS, 2024a). On a microeconomic level, physical and transition risks can affect individual businesses and households. Businesses that depend on ecosystem services like water provisioning or habitat maintenance may experience significant losses due to damage to the ecosystems relevant to them. On a macroeconomic level, physical and transition risks may have implications for prices, productivity, investment, fiscal balances and trade and capital flows, affecting inflation and GDP.

Overall, the micro and macro-economic and financial impacts of these events are intensifying, and could worsen in the future. For example, the annual global direct losses from weather-related events have more than doubled since the early 2000s, reaching over USD 200 billion in 2025.[2] Some examples and projections of negative GDP impacts and other economic impacts from nature-related risks are provided in the table below.

Figure B.1 **Transmission of nature-related risks to the economy and the financial system**[1]



1 See also figure 4 of (IMF, 2024) for a complementary description of to, from and within the financial system.
Source: (NGFS, 2024a).

1 e.g. through carbon pricing or phase-out of fossil fuels.

2 The increase is attributable to a variety of factors, including extreme weather events, but also exposure of assets and increase in insurance coverage (Munich Re, 2026).

Table B.2 **Examples of micro and macro-economic impacts from climate and nature-related risks**

Micro	In 2022, severe drought conditions in China's Sichuan province resulted in severe power shortages, forcing local industries to halt operations, including factory shutdowns (The Guardian, 2022).
Micro	A 2023 report by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) reported that the cost of invasive species has quadrupled every decade since 1970. In 2019, global annual costs of biological invasions were estimated, conservatively, to exceed USD 423 billion (IPBES, 2023).
Macro	Climate disasters could cause large GDP losses at the regional level, ranging from 6% in Asia up to 12.5% of GDP for Africa (NGFS, 2025a).
Macro	Supply chain disruptions due to regional weather events could inflate transition costs, lowering European GDP by 1.7%, North American GDP by 0.8%, and African GDP by 6.4% by 2030 (NGFS, 2025a).
Macro	A sudden wakeup call scenario may result in an increase in 2% of the worldwide unemployment rate when compared to a "Highway to Paris" scenario, and an increase of inflation in North America by about 4.8% in 2027 (NGFS, 2025a).
Macro	Research by the ECB, together with the University of Oxford, shows that 15% of the euro area's economic output is at risk due to water scarcity (ECB, 2025c).

It is important to note that some macroeconomic indicators may not fully capture the adverse impacts of nature degradation. Nature-related risks do not always translate into negative GDP outcomes, which may lead to an underestimation of the costs. Indeed, recovery spending following a weather event may increase GDP as welfare, health, ecosystems and social stability may have deteriorated (Green Futures Solutions, 2026). As a result, GDP-based measures can mask underlying damage and fail to accurately reflect overall costs. Moreover, the scope of impacts – whether direct or second round effects can lead to significant variations in their assessment of impacts (NGFS, 2026c).

Acknowledgements

This publication is a collaborative effort of the members of the NGFS Workstream on Supervision. It was prepared under the leadership of the Workstream on Supervision Co-Chairs, Alberto Casillas (Banco de España) and Donald Chen (Hong Kong Monetary Authority).

The drafting of the publication was co-led by Valeria Lionetti (Banca d'Italia), Patricia Mora (Banco de Portugal), Naelle Verniest (European Central Bank), and Sindiswa Kgopane (South African Reserve Bank). The Co-Chairs are grateful for the contributions of Sarah Kaber (Autorité de Contrôle Prudentiel et de Résolution), Paul Champey (Banque de France), Luis Eduardo Stancato de Souza (Banco Central do Brasil), Lourdes Ramos (Banco de España), Jacqueline P. Martínez Marx and Rafael Robles Martinez (Banco de México), Giacomo Manzelli and Paolo Soprani (Banca d'Italia), Mary Ann Cube and Rhodora Brazil De Vera (Bangko Sentral ng Pilipinas), Joseph Kenene (Bank of Tanzania), Sivanesan a/l Daybalan, Lodylia Shahril, Vaayu Puthran a/l Shanmugalingam, and Sellina Mohd Redzuan Hutagalung (Bank Negara Malaysia), Dominik Leichinger, Olivier Michelmann, and Niklas Schmeyer (Deutsche Bundesbank), Rafaela Barros Diniz (European Central Bank), Ida Lindström and Rasmus Rodhe (Finansinspektionen, Sweden), Leandro D'Aurizio (Istituto per la Vigilanza sulle Assicurazioni), Deepa Cherian (Monetary Authority of Singapore), Hu Xiaofan and Lou Dan (People's Bank of China), Tshegofatso Mudau (South African Reserve Bank), and Anne Feidt (Swiss Financial Market Supervisory Authority).

The work was coordinated by Willy Mak and his team, including Angus Chow (Hong Kong Monetary Authority), with the support of Joanna Chang (Australian Prudential Regulation Authority), Javier Zapico (Banco de España), Ma. Belinda Caraan (Bangko Sentral ng Pilipinas), Robin Bohn (Deutsche Bundesbank), Pume Dawedi and Koketso Modise (South African Reserve Bank), and François Lesage and Harper Kim (World Bank). The work also benefited from the support of the NGFS Secretariat: Mario Lopatriello (European Central Bank), Marie Gabet and Rachèle Sannier (Banque de France), and Lucia Wilbert (Deutsche Bundesbank).

The Co-Chairs also wish to thank the reviewers of this publication: Najwa Mouhaouri (Bank Al-Maghrib), Katerina Paisiou and Yiannis Koufakis (Bank of Greece), Amy-Jane Burrell and Tim Rawlings (Bank of England), Carine Moreira de Almeida Bastos and Enrico Dalla Riva (Banco Central do Brasil), Léo Charrel and Paul Champey (Banque de France), Johannes-Gabriel Werner, Christoph Erkunt, and Elena Triebskorn (Deutsche Bundesbank), Ryanne Cox (De Nederlandsche Bank), Ivana Baranovic, Naelle Verniest, and Tibor Fejes (European Central Bank), Charlotte Gardes-Landolfini and Ninjin Namkhaijantsan (International Monetary Fund), Miroslav Petkov (International Association of Insurance Supervisors), Sakina Kuribayashi (Japan Financial Services Agency), Viktoria Horak-Deak (Magyar Nemzeti Bank), Rosa Kajibanga and Fabio Sebastio (National Bank of Angola), Eric Simbi (National Bank of Rwanda), Vijay Singh Shekhawat and Deepak Verma (Reserve Bank of India), Sarah McPhail (South African Reserve Bank), Ashutosh Jaiswal (South East Asian Central Banks Centre), as well as CDP and the Centre for Economic Transition Expertise.

Finally, the Co-Chairs would like to thank all members of the NGFS Workstream on Supervision, Workstream on Scenarios, Task Force on Nature, Task Force on Adaptation, Experts' Network on Legal Issues, and Experts' Network on Data who contributed to the review of this publication. The contents of this publication do not necessarily reflect the views or positions of the institutions listed above.

References

Australian Prudential Regulation Authority (2022)
Climate Vulnerability Assessment – November 2022.
https://www.apra.gov.au/news-and-publications/climate-vulnerability-assessment-november-2022

Australian Prudential Regulation Authority (2024)
Climate Risk Self-Assessment Survey 2024.
https://www.apra.gov.au/news-and-publications/climate-risk-self-assessment-survey-2024

Australian Prudential Regulation Authority (2026)
Mind the Gap: An Insurance Climate Vulnerability Assessment.
https://www.apra.gov.au/news-and-publications/mind-gap-insurance-climate-vulnerability-assessment

Autorité de Contrôle Prudentiel et de Résolution (2019)
French banking groups facing climate change-related risks.
https://acpr.banque-france.fr/system/files/import/acpr/medias/documents/as_101_climate_risk_banks_en.pdf

Banco de México (2024)
Financial Stability Report.
https://www.banxico.org.mx/publications-and-press/financial-system-reports/%7B1DDCC744-D56B-0BA1-584B-52DAADCA217E%7D.pdf

Battiston *et al.* (2017)
A climate stress-test of the financial system.
https://www.nature.com/articles/nclimate3255

BCBS (2019)
Pillar 2 framework – Executive Summary.
https://www.bis.org/fsi/fsisummaries/pillar2.htm

BCBS (2021)
Climate-related risk drivers and their transmission channels.
https://www.bis.org/bcbs/publ/d517.pdf

BCBS (2022a)
Principles for the effective management and supervision of climate-related financial risks.
https://www.bis.org/bcbs/publ/d532.htm

BCBS (2022b)
Frequently asked questions on climate-related financial risks (8 December 2022), publ. d543.
https://www.bis.org/bcbs/publ/d543.htm

BCBS (2024)
The role of climate scenario analysis in strengthening the management and supervision of climate-related financial risks.
https://www.bis.org/bcbs/publ/d572.pdf

BCBS (2025)
A framework for the voluntary disclosure of climate-related financial risks.
https://www.bis.org/bcbs/publ/d597.pdf

Banque de France (2025)
Seeds of Inflation: Macro Modelling of Nature-Related Risks through Agricultural Prices.
https://www.banque-france.fr/en/publications-and-statistics/publications/seeds-inflation-macro-modelling-nature-related-risks-through-agricultural-prices

Banca d'Italia (2022a)
Supervisory guidance for climate-related and environmental risks.
https://www.bancaditalia.it/focus/sostenibilita/vigilanza-sostenibilita/en_Aspettative_di_vigilanza_BI_su_ESG.pdf

Banca d'Italia (2022b)
Indagine Tematica sul grado di allineamento delle LSI alle aspettative di vigilanza sui rischi climatici e ambientali.
https://www.bancaditalia.it/compiti/vigilanza/normativa/archivio-norme/comunicazioni/com-20221123/Rapporto_LSI_rischi_climatici_e_ambientali.pdf

Banca d'Italia (2022c)
Climate and environmental risks – Survey on a sample of non-bank financial intermediaries.
https://www.bancaditalia.it/compiti/vigilanza/normativa/archivio-norme/comunicazioni/com-20230110/index.html

Banca d'Italia (2025a)
Action plans for the integration of climate-related and environmental risks into LSI business processes: main findings and good practices.
https://www.bancaditalia.it/compiti/vigilanza/avvisi-pub/2025.05.27-lsi/Stato_di_avanzamento_e_buone_prassi_LSI_2025_EN.pdf?language_id=1

Banca d'Italia (2025b)
Piani d'azione sull'integrazione dei rischi climatici e ambientali nei processi aziendali degli intermediari non bancari: principali evidenze campionarie e nuove buone prassi.
https://www.bancaditalia.it/compiti/vigilanza/normativa/archivio-norme/comunicazioni/com-20250731/Piani-d-azione-su-integrazione-rischi-climatici-e-ambientali-nei-processi-aziendali-di-un-campione-di-INB.pdf

Bank Negara Malaysia (2021)
Climate Change and Principle-based Taxonomy.
https://www.bnm.gov.my/documents/20124/938039/Climate+Change+and+Principle-based+Taxonomy.pdf

Bank Negara Malaysia (2022)
An Exploration of Nature-Related Financial Risks in Malaysia.
https://documents1.worldbank.org/curated/en/099315003142232466/pdf/P175462094e4c80c30add50b4ef0fa7301e.pdf

Bank of England (2015)
Speech. Breaking the tragedy of the horizon – climate change and financial stability.
https://www.bis.org/review/r151009a.pdf

Bank of England (2018)
Transition in thinking: The impact of climate change on the UK banking sector.
https://www.bankofengland.co.uk/-/media/Bank of England/files/prudential-regulation/report/transition-in-thinking-the-impact-of-climate-change-on-the-uk-banking-sector.pdf

Bank of England (2022)
Results of the 2021 Climate Biennial Exploratory Scenario (CBES).
https://www.bankofengland.co.uk/stress-testing/2022/results-of-the-2021-climate-biennial-exploratory-scenario

Bank of England (2025)
Supervisory statement 5/25 – Enhancing banks' and insurers' approaches to managing climate related risks.
https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/supervisory-statement/2025/ss425-december-2025.pdf

Bangko Sentral ng Pilipinas (2024)
The Impact of Biodiversity Loss on the Philippine Banking System: A Preliminary Analysis.
https://www.bsp.gov.ph/Pages/MediaAndResearch/PublicationsAndReports/Discussion%20Papers/DP202303.pdf

Bank for International Settlements (2024)
Project Gaia, enabling climate risk analysis using generative AI.
https://www.bis.org/publ/othp84.pdf

CETEx-LSE (2025a)
Banks and climate litigation risk: navigating the low-carbon transition.
https://cetex.org/publications/banks-and-climate-litigation-risk-navigating-the-low-carbon-transition/

CETEx-LSE (2025b)
Understanding the climate-nature nexus and its implications for the economy and financial system.
https://cetex.org/publications/understanding-the-climate-nature-nexus-and-its-implications-for-the-economy-and-financial-system/

CETEx-LSE (2025c)
Integrating bank transition planning into prudential supervision.
https://cetex.org/wp-content/uploads/2025/05/Integrating-bank-transition-planning-into-prudential-supervision_CETEx.pdf

CETEx-LSE (2026a)
EU banks and nature-related risk management: from awareness to action.
https://cetex.org/publications/eu-banks-and-nature-related-risk-management-from-awareness-to-action/

CETEx-LSE (2026b)
Upgrading Housing – The Potential and Limits of Borrower-Based Measures.
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=6763518

CETEx-LSE (2026c)
The insurance-bank nexus: the climate protection gap as a source of risk for the financial system.
https://cetex.org/wp-content/uploads/2026/06/The-insurance–bank-nexus.pdf

Coalition of Finance Ministers (2025)
How Ministers of Finance can assess and manage physical climate risks and adaptation.
https://www.financeministersforclimate.org/sites/default/files/2025-06/CFCMA%20HP4%20Thematic%20Paper%20-%20Physical%20Climate%20Risks%20and%20Adaptation.pdf

De Nederlandsche Bank (2017)
Waterproof? An exploration of climate-related risks for the Dutch financial sector.
https://www.dnb.nl/media/r40dgfap/waterproof-an-exploration-of-climate-related-risks-for-the-dutch-financial-sector.pdf

De Nederlandsche Bank (2018)
An energy transition risk stress test for the financial system of the Netherlands.
https://www.dnb.nl/media/pdnpdalc/201810_nr-_7_-2018-_an_energy_transition_risk_stress_test_for_the_financial_system_of_the_netherlands.pdf

De Nederlandsche Bank (2019)
Values at risk? Sustainability risks and goals in the Dutch financial sector.
https://www.dnb.nl/media/hm1msmzo/values-at-risk-sustainability-risks-and-goals-in-the-dutch.pdf

De Nederlandsche Bank (2021a)
Balancing sustainability: integrating sustainability risks into the core processes of the financial sector.
https://www.dnb.nl/media/1lkjwpao/web_report_balancing-sustainability.pdf

De Nederlandsche Bank (2021b)
What's the damage? Monetizing the environmental externalities of the Dutch economy and its supply chain.
https://www.dnb.nl/media/50rj2svt/working_paper_no-_719.pdf

De Nederlandsche Bank (2022)
Towards more sustainable lending.
https://www.dnb.nl/media/p45ehcqw/towards-more-sustainable-lending.pdf

De Nederlandsche Bank (2024)
The ecosystem service degradation sensitivity indicator (EDSI): A new framework for understanding the financial risk repercussions of nature degradation.
https://www.ecb.europa.eu/press/conferences/shared/pdf/20241015_mppg/Paper_Gallet.pdf

De Nederlandsche Bank (2025)
Mapping Physical Climate Risk Exposure in Euro Area firms: Linking E-PRTR and RIAD with a Fuzzy Match.
https://www.dnb.nl/media/b0vmmmia/dnb-analysis-en-mapping-physical-climate-risk-exposure-in-euro-area-firms.pdf?utm_source=chatgpt.com

European Banking Authority (2023)
Report on the role of environmental and social risks in the prudential framework.
https://www.eba.europa.eu/sites/default/files/document_library/Publications/Reports/2023/1062711/Report%20on%20the%20role%20of%20environmental%20and%20social%20risks%20in%20the%20prudential%20framework.pdf

European Banking Authority (2025)
Guidelines on environmental scenario analysis.
https://www.eba.europa.eu/sites/default/files/2025-11/170da4c8-9b56-4fb0-ad60-94d433b7e866/Guidelines%20on%20environmental%20scenario%20analysis.pdf

European Banking Authority (2026)
Guideline on the management of ESG risks.
https://www.eba.europa.eu/activities/single-rulebook/regulatory-activities/sustainable-finance/guidelines-management-esg-risks

European Commission (2024)
Zero Pollution: New EU rules enter into force for cleaner air by 2030.
https://environment.ec.europa.eu/news/new-pollution-rules-come-effect-cleaner-air-2030-2024-12-10_en

ECB (2019)
Climate change and financial stability.
https://www.ecb.europa.eu/press/financial-stability-publications/fsr/special/html/ecb.fsrart201905_1~47cf778cc1.en.html#toc5

ECB (2021)
ECB economy-wide climate stress test.
https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op281~05a7735b1c.en.pdf

ECB (2022)
Good practices for climate-related and environmental risk management. Observations from the 2022 thematic review.
https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.thematicreviewcercompendiumgoodpractices112022~b474fb8ed0.en.pdf

ECB (2023)
Speech. "Come hell or high water": addressing the risks of climate and environment-related litigation for the banking sector.
https://www.ecb.europa.eu/press/key/date/2023/html/ecb.sp230904_1~9d14ab8648.en.html

ECB (2024a)
Speech. Nature-related risk: legal implications for central banks, supervisors and financial institutions.
https://www.ecb.europa.eu/press/key/date/2024/html/ecb.sp240906~54436f6891.en.html

ECB (2024b)
Birth of a naturalist? Nature-related risks and biodiversity loss: legal implications for the ECB.
https://www.ecb.europa.eu/pub/pdf/scplps/ecb.lwp24~643ca542d0.en.pdf

ECB (2024c)
Risk from misalignment of banks' financing with the EU climate objectives.
https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.bankingsectoralignmentreport202401~49c6513e71.en.pdf

ECB (2025a)
Nature at risk: Implications for the euro area economy and financial stability.
https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op380.en.pdf

ECB (2025b)
The ECB blog. Banks have made good progress in managing climate and nature risks – and must continue.
https://www.ecb.europa.eu/press/blog/date/2025/html/ecb.blog20250711~f5c6a0259f.en.html

ECB (2025c)
Speech. Nature's bell tolls for thee, economy!
https://www.ecb.europa.eu/press/key/date/2025/html/ecb.sp250522~b371549cb6.en.html

ECB (2026a)
Good practices for climate and nature risk management. Observations from the ECB's five year climate and nature risk programme (2020-25).
https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.thematicreviewcercompendiumgoodpractices052026.en.pdf

ECB (2026b)
ECB report on good practices for climate and nature-related risk stress testing.
https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.202605_ECBreport_on_good_practices_for_climate_and_nature_stress_testing.en.pdf

ECB-ESRB (2023)
Towards macro-prudential frameworks for managing climate risk.
https://www.esrb.europa.eu/pub/pdf/reports/esrb.report202312~d7881028b8.en.pdf

EIOPA (2019)
Financial Stability Report, Climate risk assessment of the sovereign bond portfolio of European insurers.
https://www.eiopa.europa.eu/document/download/2f3f5428-052e-4c97-8229-a2f37165125e_en?filename=%20Climate%20risk%20assessment%20of%20the%20sovereign%20bond%20portfolio%20of%20European%20insurers%20-%20Thematic%20article%20-%20December%202019.pdf

EIOPA (2021)
Opinion on the supervision of the use of climate change risk scenarios in ORSA.
https://www.eiopa.europa.eu/publications/opinion-supervision-use-climate-change-risk-scenarios-orsa_en

EIOPA (2022)
Application guidance on climate change materiality assessments and climate change scenarios in ORSA.
https://www.eiopa.europa.eu/publications/application-guidance-climate-change-materiality-assessments-and-climate-change-scenarios-orsa_en

EIOPA (2023a)
Staff Paper on Policy options to reduce the climate insurance protection gap.
https://www.eiopa.europa.eu/publications/staff-paper-policy-options-reduce-climate-insurance-protection-gap_en

EIOPA (2023b)
Staff Paper on nature-related risks and impacts for Insurance for insurance.
https://www.eiopa.europa.eu/publications/eiopa-staff-paper-nature-related-risks-and-impacts-insurance_en

EIOPA (2024)
EIOPA's Final Report and Opinion on Greenwashing – Advice to the European Commission.
https://www.eiopa.europa.eu/publications/eiopas-final-report-and-opinion-greenwashing-advice-european-commission_en

FINMA (2019)
FINMA Risk Monitor 2019.
https://www.finma.ch/en/~/media/finma/dokumente/dokumentencenter/myfinma/finma-publikationen/risikomonitor/20191210-finma-risikomonitor-2019.pdf?sc_lang=en&hash=883D20C10BF1C613EEDF99E3F0939100

FINMA (2020)
Press release. FINMA addresses climate risks in the financial sector.
https://www.finma.ch/en/news/2020/06/20200626-mm-sustainable-finance/

FINMA (2024)
Circular 2026/1: Nature-related financial risks.
https://www.finma.ch/en/~/media/finma/dokumente/dokumentencenter/myfinmarundschreiben/finma-rs-2026-01.pdf?sc_lang=en&hash=8D72D84C2DF2489DA571190B3C760C90

FSB (2024)
Stocktake on Nature-related Risks: Supervisory and regulatory approaches and perspectives on financial risk.
https://www.fsb.org/uploads/P180724.pdf

FSB (2025)
Assessment of Climate-related Vulnerabilities: Analytical framework and toolkit.
https://www.fsb.org/2025/01/assessment-of-climate-related-vulnerabilities-analytical-framework-and-toolkit/

Green Finance Institute (2024)
Assessing the Materiality of Nature-Related Financial Risks for the UK.
https://www.greenfinanceinstitute.com/hive/assessing-the-materiality-of-nature-related-financial-risks-for-the-uk/

Green Futures Solutions (2026)
Recalibrating Climate Risk.
https://greenfuturessolutions.com/wp-content/uploads/2026/01/Recalibrating-Climate-Risk-Report-Final.pdf

Government of Brazil (2025)
Sustainable Taxonomy of Brazil.
https://www.gov.br/fazenda/pt-br/orgaos/spe/sustainable-taxonomy-of-brazil

Government of Uganda (2025)
National Green Taxonomy.
https://www.finance.go.ug/sites/default/files/reports/National%20Green%20Taxonomy%202025.pdf

Grantham Research Institute (2023)
Impacts of climate litigation on firm value.
https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2023/05/working-paper-397_-Sato-Gostlow-Higham-Setzer-Venmans.pdf

Grantham Research Institute (2025)
Global trends in climate change litigation: 2025 snapshot.
https://www.lse.ac.uk/granthaminstitute/publication/global-trends-in-climate-change-litigation-2025-snapshot/

Hong Kong Monetary Authority (2024)
Sustainable Finance Action Agenda.
https://www.hkma.gov.hk/media/eng/doc/key-information/press-release/2024/20241021e4a1.pdf.

IAIS (2023)
A call to action: the role of insurance supervisors in addressing natural catastrophe protection gaps.
https://www.iais.org/uploads/2023/11/IAIS-Report-A-call-to-action-the-role-of-insurance-supervisors-in-addressing-natural-catastrophe-protection-gaps.pdf

IAIS (2025a)
Application Paper on the supervision of climate-related risks in the insurance sector.
https://www.iais.org/uploads/2025/04/Application-Paper-on-the-supervision-of-climate-related-risks-in-the-insurance-sector.pdf

IAIS (2025b)
Global Insurance Market Report (GIMAR). Potential financial stability implications of natural catastrophe insurance protection gaps.

IFRS (2023a)
IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Information.
https://www.ifrs.org/issued-standards/ifrs-sustainability-standards-navigator/ifrs-s1-general-requirements/

IFRS (2023b)
IFRS S2 Climate-related Disclosures.
https://www.ifrs.org/issued-standards/ifrs-sustainability-standards-navigator/ifrs-s2-climate-related-disclosures/

IMF (2021)
Climate-Related Stress Testing: Transition Risk in Colombia.
https://www.imf.org/en/publications/wp/issues/2021/11/05/climate-related-stress-testing-transition-risk-in-colombia-504344

IMF (2024)
Embedded in Nature: Nature-Related Economic and Financial Risks and Policy Considerations.
https://www.imf.org/en/publications/staff-climate-notes/issues/2024/10/01/embedded-in-nature-nature-related-economic-and-financial-risks-and-policy-considerations-555072

IPBES (2019)
The global assessment report on biodiversity and ecosystem services.
https://files.ipbes.net/ipbes-web-prod-public-files/inline/files/ipbes_global_assessment_report_summary_for_policymakers.pdf

IPBES (2023)
Invasive Alien Species Assessment.
https://ict.ipbes.net/ipbes-ict-guide/data-and-knowledge-management/citations-of-ipbes-assessments/invasive-alien-species-assessment

IPCC (2023)
Sixth Assessment Report.
https://www.ipcc.ch/assessment-report/ar6/

IVASS (2025)
Natural catastrophes and sustainability risks: Annual monitoring.
https://www.ivass.it/pubblicazioni-e-statistiche/pubblicazioni/stabilita-finanziaria/2025/2025-rischi-cat-nat/Rischi_da_catastrofi_naturali_e_di_sostenibilita_monitoraggio_annuale_2025_EN.pdf?language_id=3

Magyar Nemzeti Bank (2019)
Supervisory green programme.
https://zoldpenzugyek.mnb.hu/supervisory-green-programme

Munich Re (2020)
Natural catastrophes in 2019.
https://www.munichre.com/content/dam/munichre/contentlounge/website-pieces/documents/media-relations/Factsheet-natural-disasters-2019.pdf/_jcr_content/renditions/original./Factsheet-natural-disasters-2019.pdf

Munich Re (2026)
Climate change presses on: Devastating wildfires and intense thunderstorms exacerbate losses for insurers.
https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2026/natural-disaster-figures-2025.item-f4908b8a46398cbd7f6f4f0492e80308.html

NGFS (2019)
A call for action: Climate change as a source of financial risk.
https://www.ngfs.net/system/files/import/ngfs/medias/documents/ngfs_first_comprehensive_report_-_17042019_0.pdf

NGFS (2020)
Guide for Supervisors: Integrating climate-related and environmental risks into prudential supervision.
https://www.ngfs.net/system/files/import/ngfs/medias/documents/ngfs_guide_for_supervisors.pdf

NGFS (2022)
Central banking and supervision in the biosphere: An agenda for action on biodiversity loss, financial risk and system stability.
https://www.ngfs.net/system/files/import/ngfs/medias/documents/central_banking_and_supervision_in_the_biosphere.pdf

NGFS (2023a)
Stocktake on Financial Institutions' Transition Plans and their Relevance to Micro-prudential Authorities.
https://www.ngfs.net/system/files/import/ngfs/medias/documents/stocktake_on_financial_institutions_transition_plans.pdf

NGFS (2023b)
Climate-related litigation: recent trends and developments.
https://www.ngfs.net/en/publications-and-statistics/publications/report-climate-related-litigationrecent-trends-and-developments

NGFS (2023c)
Report on micro-prudential supervision of climate-related litigation risks.
https://www.ngfs.net/system/files/import/ngfs/medias/documents/ngfs_report-on-microprudential-supervision-of-climate-related-litigation-risks.pdf

NGFS (2023d)
Recommendations toward the development of scenarios for assessing nature-related economic and financial risks.
https://www.ngfs.net/system/files/import/ngfs/medias/documents/ngfs_nature_scenarios_recommendations.pdf

NGFS (2024a)
Nature-related Financial Risks: a Conceptual Framework to guide Action by Central Banks and Supervisors.
https://www.ngfs.net/system/files/import/ngfs/medias/documents/ngfs-conceptual-framework-nature-risks.pdf

NGFS (2024b)
Nature-related litigation: emerging trends and lessons learned from climate-related litigation.
https://www.ngfs.net/system/files/import/ngfs/medias/documents/report-nature-related-litigation-emerging-trends-lessons-climate.pdf

NGFS (2024c)
Conceptual Note on Adaptation.
https://www.ngfs.net/system/files/import/ngfs/medias/documents/ngfs_conceptual_note_on_adaptation.pdf

NGFS (2024d)
Transition Plan Package.
https://www.ngfs.net/en/publications-and-statistics/publications/ngfs-transition-plan-package

NGFS (2025a)
NGFS Short-Term Scenarios for central banks and supervisors.
https://www.ngfs.net/system/files/2025-05/NGFS%20Short-term%20scenarios_Presentation_1.pdf

NGFS (2025b)
Guide to climate scenario analysis for central banks and supervisors – Update.
https://www.ngfs.net/system/files/2025-11/Guide%20to%20climate%20scenario%20analysis%20for%20central%20banks%20and%20supervisors%20%E2%80%93%20Update_0.pdf

NGFS (2025c)
Integrating adaptation and resilience into transition plans.
https://www.ngfs.net/system/files/2025-07/NGFS_G20_Input%20paper_final%20%281%29_0.pdf

NGFS (2025d)
Climate Target setting and Transition Plans.
https://www.ngfs.net/en/press-release/ngfs-publishes-two-notes-relating-transition-plans-climate-target-setting-and-climate-scenario

NGFS (2025e)
Interactions between Climate Scenario Analysis and Transition Plans.
https://www.ngfs.net/en/press-release/ngfs-publishes-two-notes-relating-transition-plans-climate-target-setting-and-climate-scenario

NGFS (2026a)
Note on the supervision of nature-related financial risks.
https://www.ngfs.net/system/files/2026-04/NGFS_Supervision%20of%20nature%20risks.pdf

NGFS (2026b)
Navigating nature-related data: metrics, sources and uses.
https://www.ngfs.net/en/publications-and-statistics/publications/navigating-nature-related-data-metrics-sources-and-uses

NGFS (2026c)
NGFS Note on the economic and financial impacts of extreme weather events.
https://www.ngfs.net/system/files/2026-05/NGFS_Note%20on%20extreme%20weather%20events.pdf

NGFS (2026d)
Summary Note on the Improvement of Modelling Tools for Nature-Related Financial Risks Scenarios.
https://www.ngfs.net/en/publications-and-statistics/publications/summary-note-improvement-modelling-tools-nature-related-financial-risk-scenarios

NGFS (forthcoming)
Nature-related Financial Risks: a Compendium of Implementation Practices to Guide Action by Central Banks and Supervisors.

Qi Lui *et al.* (2026)
Global warming intensifies extreme day-to-day temperature changes in mid-low latitudes.
https://www.nature.com/articles/s41558-025-02486-9

Solana (2020)
Climate change litigation as financial risk. mate change litigation as financial risk. *Green Finance*, 2020, 2(4): 344-372.
https://www.aimspress.com/article/doi/10.3934/GF.2020019

South African Reserve Bank (2022)
Prudential Communication 10 of 2022.
https://www.resbank.co.za/content/dam/sarb/publications/prudential-authority/pa-public-awareness/covid-19-response/2022/Prudential%20Communication%2010%20of%202022%20-%20Climate-related%20Risks.pdf

South African Reserve Bank (2025)
Guidance on Climate-related Disclosures for Banks.
https://www.resbank.co.za/content/dam/sarb/publications/prudential-authority/pa-deposit-takers/banks-guidance-notes/2025/g3-2025/G3-2025-%20Guidance%20Note%20Climate%20Disclosures%20for%20banks.pdf

Spacey Martín *et al.* (2026)
Empirically assessing corporate adaptation and resilience disclosure using AI.
https://www.nature.com/articles/s44168-025-00321-7

Swiss Re (2022)
Blog. Insurers need to step up to close the flood protection gap.
https://www.swissre.com/risk-knowledge/risk-perspectives-blog/insurers-step-up-to-close-flood-protection-gap.html

Swiss Re (2025)
Natural catastrophes: insured losses on trend to USD 145 billion in 2025.
https://www.swissre.com/institute/research/sigma-research/sigma-2025-01-natural-catastrophes-trend.html

The Guardian (2022)
China drought causes Yangtze to dry up, sparking shortage of hydropower.
https://www.theguardian.com/world/2022/aug/22/china-drought-causes-yangtze-river-to-dry-up-sparking-shortage-of-hydropower

The Guardian (2025)
Nasa data reveals dramatic rise in intensity of weather events.
https://www.theguardian.com/world/2025/jun/17/nasa-data-reveals-dramatic-rise-in-intensity-of-weather-events

TNFD (2025)
TNFD 2025 Status Report.
https://tnfd.global/wp-content/uploads/2025/09/250918_TNFD-Status-Report_DIGITAL.pdf?v=1758808860

UNDRR (2025)
Global Assessment Report on Disaster Risk Reduction.
https://www.undrr.org/gar/gar2025

UNEP (2024)
Adaptation Gap Report 2024.
https://www.unep.org/resources/adaptation-gap-report-2024

UNEP (2025a)
Emissions Gap Report 2025.
https://www.unep.org/resources/emissions-gap-report-2025

Várgedő, B., Burger, Cs., Kim, D. (2024)
Green Firms Are Less Risky: Results from a Preferential Capital Requirement Programme in Emerging Europe.
https://zoldpenzugyek.mnb.hu/sw/static/file/20250317_burger_kim_vargedo_green_firms_are_less_risky.pdf

World Bank Group (2021)
The Economic Case for Nature: A Global Earth-Economy Model to Assess Development Policy Pathways.
https://openknowledge.worldbank.org/entities/publication/fcc11682-c752-51c4-a59f-0ab5cd40dc6f

World Bank Group (2024a)
Finance and Prosperity 2024.
https://www.worldbank.org/en/publication/finance-and-prosperity-2024

World Bank Group (2024b)
Double trouble? Assessing Climate Physical and Transition Risks for the Moroccan Banking Sector.
https://documents1.worldbank.org/curated/en/099040924013528667/pdf/P175074-39948cec-1447-410a-ae59-466b51bbb4d6.pdf

World Health Organization (2025)
Climate change and global health: WHO calls for migrant-inclusive and climate-resilient health systems.
https://www.who.int/news/item/06-08-2025-climate-change-and-global-health--who-calls-for-migrant-inclusive-and-climate-resilient-health-systems

World Meteorological Organization (2026)
State of the Global Climate 2025.
WMO-No.1391.
https://library.wmo.int/records/item/69807-state-of-the-global-climate-2025

WWF (2024)
Living Planet Report 2024.
https://livingplanet.panda.org/

BANQUE DE FRANCE
EUROSYSTÈME

NGFS
Secretariat