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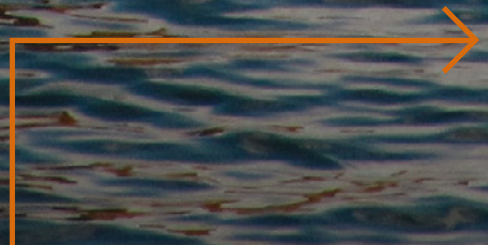
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# Physically Fit?

How financial institutions can better disclose  
climate-related physical risks in line with  
the recommendations of the TCFD

December 2022



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# Executive summary

## Context

In 2017, the Financial Stability Board (FSB) launched the Taskforce on Climate-related Financial Disclosures (TCFD), which published its recommendations and guidance on assessing and disclosing the risks of climate change by corporates and financial institutions. The TCFD recommendations categorised climate-related risks into two principal categories: transition risks from the shift to a lower-carbon economy, and physical risks from the physical impacts of climate change.

**Climate-related risk disclosures by financial institutions tend to focus more on transition risks, resulting in a possible physical risks “blind spot.”** In current TCFD-aligned reporting, quantitative disclosures are more widely available for transition risks than physical risks, which have been typically discussed in qualitative terms (TCFD 2021a). Regulators, including the European Central Bank (ECB) and the U.S. Securities and Exchange Commission (SEC) have also found physical risks to be less commonly disclosed relative to transition risks in ECB-supervised banks<sup>1</sup> and Russell 3000 companies<sup>2</sup> (ECB 2020b; ECB 2022; SEC 2022).

**Specific guidance on the assessment and disclosure of physical climate-related risks tends to be less widespread than guidance on transition risks.** In order to drive more widespread disclosure of climate risks, the TCFD updated its implementation guidance in 2021, released a report on “Metrics, Targets, and Transition Plans,” and published supporting guidance on the use of scenario analysis for non-financial corporates (TCFD 2021b; TCFD 2021c; TCFD 2021d). Supervisors and regulators have also identified the gap in disclosures of physical climate risk (ECB 2020b; ECB 2022; SEC 2022), and the ECB has developed climate-related and environmental risk guidance, according equal import to both physical and transition risks (ECB 2020a). This report aims to underline the key physical risk elements of a climate-related disclosure.

- 1 The ECB found in 2020 that around 54% of institutions reviewed do not disclose the impact of transition risks on their business strategy, compared to 56% of institutions not disclosing the impact of physical risks (ECB 2020b). More recently, the ECB finds that “31% of banks disclose a strategic impact of both physical and transition risk, 10% of transition risk only and 2% of physical risk only” (ECB 2022).
- 2 The SEC’s findings arise from analysis of 10-K filings submitted to the Commission between 27 June 2019 and 31 December 2020.

## About this report

This report concentrates on physical risk disclosure practices by financial institutions and provides a resource for them to develop such disclosures. The authors used three principal methods to identify current good practices and to develop guidance:

- Desk research
- Engagement with financial institutions through webinars, a survey, and a workshop
- Review of publicly available disclosures by a sample of financial institutions who are leading on climate change mitigation and net zero under the Glasgow Financial Alliance for Net Zero (GFANZ).

Physical risk assessment and disclosure is not part of finance sector net-zero frameworks, but these populations of financial institutions were sampled as they constitute a climate leadership group which is taking a ‘double materiality’ approach to climate, i.e. not only addressing what impact they are having on the climate, but also assessing what impact the climate will have on their businesses.

This report covers three of the four TCFD thematic areas—Strategy, Risk Management, and Metrics and Targets—and eight of the eleven TCFD-recommended disclosures. The Governance recommendations were excluded from this report as they do not cover physical or transition risks specifically, but rather, overall climate-related risks. We also excluded the second recommended disclosure of the Metrics and Targets thematic area, which concerns greenhouse gas (GHG) emissions and is therefore not directly relevant for physical risks.

## Key findings

Our review of publicly available disclosures shows that the identification, measurement, and disclosure of climate-related physical risks by financial institutions are currently incomplete and inadequate for stakeholders to assess the extent of physical risks facing these institutions and their clients. No financial institution in the sample had responded in full to all of the TCFD-recommended disclosures for physical risks. Financial institutions should improve key principles for disclosures, particularly around comparability, reliability, and objectivity. This should be supported by policy makers and regulators through better methods, data, more detailed definitions of supervisory expectations, and by a level playing field in implementation.

Less than half of the financial institutions surveyed have reported on physical risk analysis in their climate disclosures. UNEP FI and WRI carried out a qualitative assessment of the most recent climate-related risk disclosures published by 109 banks and 71 asset owners committing to climate change mitigation targets as of 1 April 2022, to rate the quality of reporting of climate-related physical risks and identify good practice. Of these disclosures, 57 of the banks (48%) and 25 of the asset owners (35%) included some assessment of physical risks. Consumers of disclosures may find some disclosures helpful in understanding the climate-related physical risks for a specific financial institution, but it is currently very hard to compare disclosures by different financial institutions even if they are in the same industry within the financial sector.

Around a quarter of the banks assessed have conducted a form of physical risk scenario analysis. Of those banks, less than 20% are assessing the impact of those scenarios on their businesses. The majority of climate-related disclosures published by financial institutions in our sample provide only high-level qualitative information on physical risks.

Scenario-based physical risk assessments currently reported in disclosures focus on a limited set of hazards and usually one or two sectors. In many cases, these assessments focus on the impact of flooding on the real estate sector in the lending or investing portfolio. Real estate is an obvious first choice given the homogeneous character of the sector and the generally good availability of both asset and flooding data, although evaluating the financial risks from these potential impacts is still a challenge. Disclosures in general do not take into account the risks across portfolios from a range of climate-related hazards or the consequences of multiple concurrent hazards and knock-on impacts.

Physical risk assessments based on historical data can provide useful information on current risks but should not be a substitute for climate-related risk assessments based on data from forward-looking climate models. Given that climate change will tend to drive ever greater extremes, assessments based on historical data can underestimate potential losses.

## Physical risk disclosure guidance

Drawing from research and practical experience from leading financial institutions, Section 3 of this report provides high-level guidance for financial institutions reporting on physical risks in line with the recommendations of the TCFD. The guidance describes the key components a financial institution should cover in the disclosure of physical climate risks, based on a review of best practices, regulations, standards, data availability, and technical considerations. Across the eight recommendations of the TCFD mentioned above, the guidance covers:

- 1. Base-level disclosures:** These are the foundational steps that all financial institutions can take to make a qualitative assessment of physical climate risks across their portfolios. These steps are based on our review of financial institutions' disclosure practices, as well as the requirements of regulators and supervisors.
- 2. Next-level disclosures:** Given existing technical parameters and data availability, these are steps that financial institutions can take to deliver more granular disclosures of physical climate risks with quantitative assessments in high-risk sectors and geographies. While such disclosures may require more analysis than base-level disclosures, all institutions should be moving in this direction, while regulations and standards should encourage more granular disclosures over time.
- 3. Further considerations:** There are a range of open questions that financial institutions should consider as they develop their physical climate risk assessments, which may currently be challenging. However, as methodologies, capacity, and data availability are rapidly advancing, these questions may be answered over the next three years.

## Areas for further work

While this report highlights some reasons for the under-reporting of physical risks, a comprehensive survey of financial institutions would better identify the barriers to more widespread and granular disclosure. Anonymised surveys across financial institutions including boards; senior management; risk analysts; environmental, social, and governance (ESG)/sustainability teams could uncover to what extent, for example, governance, capacity, data availability, costs, client relationships, etc., influence the decision to assess and disclose physical climate risks and the extent of those assessments.

Providing more technical details and standards to existing physical risk frameworks could increase the capacity of organisations to identify, assess, and disclose physical risks. The TCFD recommendations provide a high-level standardised disclosure framework, but standardised definitions, guiding principles, and methods to quantify hazards, exposure, and vulnerability, based on the latest climate science, would provide a common foundation for physical risk assessment. This would help address the complexity and technicality of physical risks and make disclosures more complete and consistent. We do not aim in this report and guidance to define how such a framework should be developed or by whom, but it would need to be global in scope, with regional granularity, and be developed collaboratively across institutions that could adopt and integrate standards into existing frameworks (see also NGFS 2022).

Expanding access to physical risk data and integrating climate risk assessments with client data, as well as further innovations in data management and assessment methodologies can improve the quality and decision-usefulness of physical risk disclosures.

- **Internal data.** Internally, financial institutions should enhance data-aggregating across risk, client, and finance systems, such as customer asset location and specification data.
- **External data.** Externally, open-source developers should be supported to provide data for key physical hazards that will scale the implementation of physical risk assessments, particularly by smaller organisations and in regions with poorer data coverage. Policymakers should support and encourage access to open-source data, building on the work of the G20 Data Gaps Initiative<sup>3</sup> and the NGFS data workstream.<sup>4</sup>
- **Methodology.** Financial institutions are encouraged to develop methods that can quantify physical hazard probabilities and physical impacts for a given asset location across various timescales and scenarios while considering an asset's unique vulnerability to different types of climate hazards. Harmonisation of methodological standards, as described above, can facilitate this.

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3 The G20 Data Gaps Initiative led by the International Monetary Fund (IMF) published a workplan consisting of 14 recommendations to address statistical and data priorities, seven of which are focused on climate change. One of those recommendations is to identify physical and transition risk indicators to support policy development and analysis.

4 The Central Banks and Supervisors Network for Greening the Financial System (NGFS) published its "Final report on bridging data gaps" in July 2022, which outlines how the workstream has mapped data needs, sources, and gaps to support a set of policy recommendations on data challenges (NGFS 2022).



- **Models.** In scenario analysis, differences between climate models are one of the major uncertainties in climate projection, particularly in the near- to medium-term time horizons (e.g., within three decades). Financial institutions are encouraged to assess the distribution of multi-model ensembles for a given climate scenario, rather than a single mean/median value or outputs from a single climate model to incorporate such uncertainties in scenario analysis.
- **Metrics.** Metrics define how methodologies are designed and how models are used. Harmonising metrics that are well-defined and decision-useful would improve the transparency and comparability of risk disclosures.
- **Transparency.** Data and methodology transparency is essential so that consumers of physical risk disclosures can understand the source of data, underlying assumptions, and methodologies. Those are prerequisites to understand and interpret physical risk disclosures.
- **Interaction effects.** An assessment of a single climate hazard on a limited selection of a portfolio can only provide a partial picture of potential physical risks. Developing the methodologies to assess the impacts of multiple concurrent climate-related hazards, transition-related risks, and wider socioeconomic risks that could arise independently or as a consequence of climate change would provide financial institutions a more realistic picture of potential forward-looking risks.

# Introduction

## 1.1 TCFD Recommendations and Physical Risk

The year 2015 marked the launch of the Paris Agreement, which forms the framework of the current international policy response to address climate change. Subsequently, the Financial Stability Board (FSB) launched the Taskforce on Climate-related Financial Disclosures (TCFD), which published its recommendations and guidance on assessing and disclosing the risks of climate change by corporates and financial institutions in 2017. The “outside-in” approach of the TCFD’s framework encouraged firms to measure the financial impact of climate change on their businesses. By March 2022, over 1,400 businesses had registered their support of the TCFD, and the recommendations of the Taskforce has become a globally recognized standard for the identification, assessment, and disclosure of climate-related risks.

The TCFD recommendations categorised climate-related risks into two principal categories ([Figure 1](#)):

- Transition risks: The shift to a climate-resilient, lower-carbon economy may give rise to extensive policy, legal, technology, and market changes.
- Physical risks: The direct physical impacts of climate change may be event-driven (acute) or result in longer-term changes in climate and natural cycles (chronic).

**Figure 1: Climate-related risks, opportunities, and financial impact**

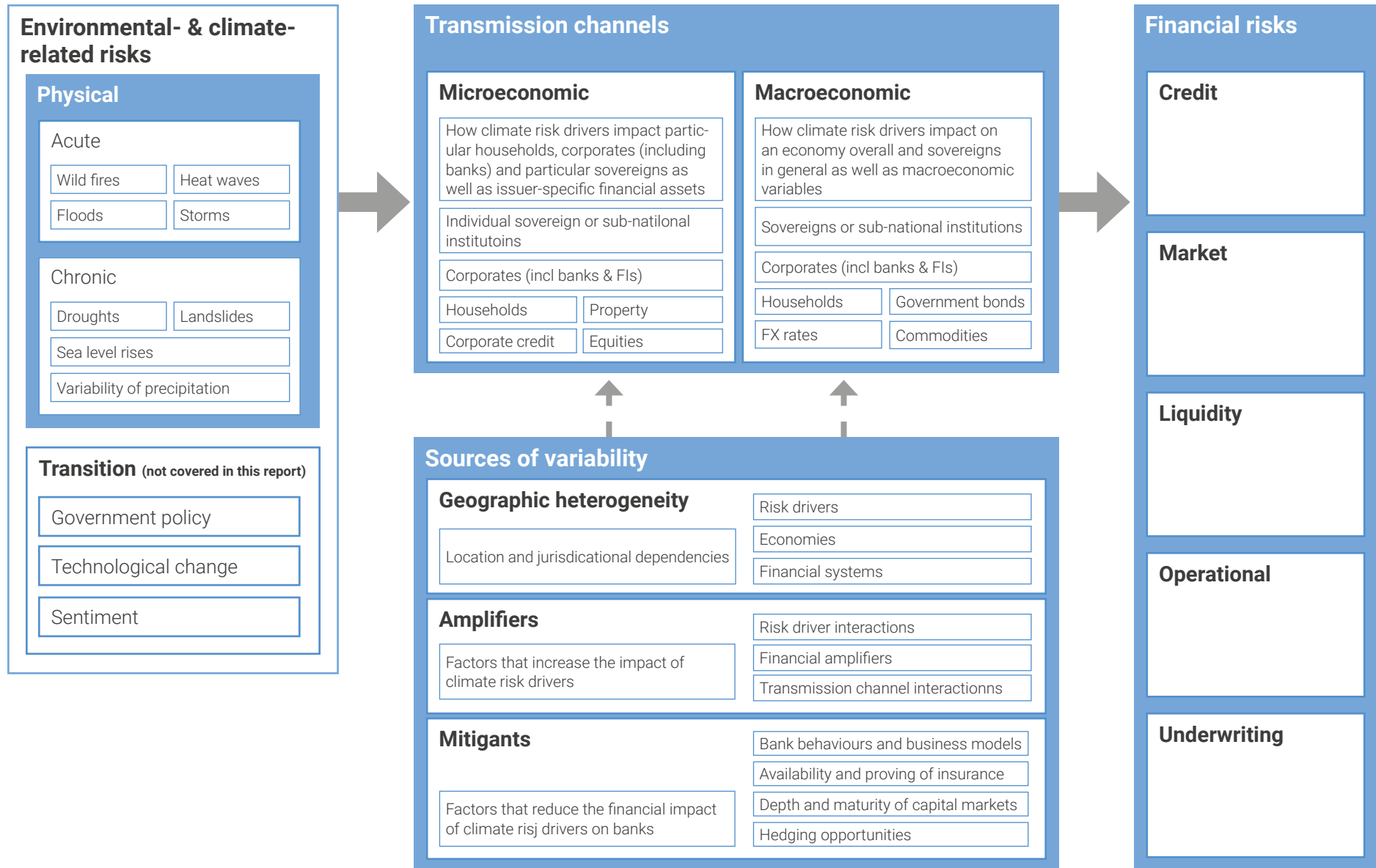


Source: TCFD 2017

Organisations, including financial institutions, following the recommendations of the TCFD, are expected to report on both of these risks, but recommendations have prioritised transition risks—this can be seen in its recommendation of a “2°C [celsius] or lower scenario” and measurement of greenhouse gas (GHG) emissions. The TCFD’s “2021 Status report” notes that quantitative disclosures of potential impacts were found more often for transition risks than physical risks, which were typically discussed as qualitative descriptions (TCFD 2021a). The European Central Bank (ECB) has also highlighted the lower disclosure of physical risks relative to transition risks by ECB-supervised banks (ECB 2020b; ECB 2022). The U.S. Securities and Exchange Commission (SEC), meanwhile, found that the majority of disclosures in annual security filings from Russell 3000 companies since 2010 were focused on transition rather than physical risks (SEC 2022). The disparity in transition and physical risk reporting is even reflected at the central bank level with the Central Banks and Supervisors Network for Greening the Financial System (NGFS) highlighting the poor response of its members to assessing physical risks relative to transition risks (NGFS 2021).

Financial institutions can be exposed to physical risk through various transmission channels (see [Figure 2](#)), but current physical disclosures are still lagging behind transition risk disclosures, particularly with regards to decision-useful and quantitative information. The Intergovernmental Panel on Climate Change’s (IPCC) Sixth Assessment Report (AR6) provides strong evidence that physical impacts from climate change are already being felt across the globe and will continue to intensify (IPCC 2021; IPCC 2022). This guide is intended to assess current physical risk reporting practices and highlight the key components for financial institutions that seek to publish disclosures. Box 1 discusses the building blocks for physical risks assessment and transmission channels from physical risks to financial risks.

Figure 2: Transmission channels: climate-related risks to financial risks



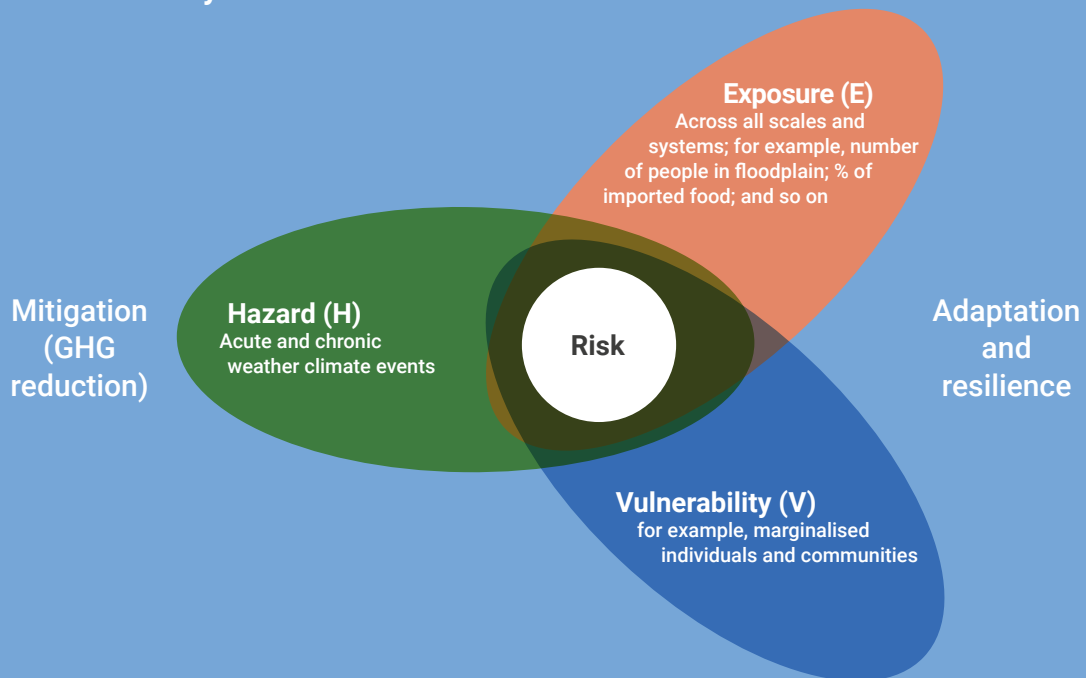
Notes: ESG = Environmental, social, and governance; FX rates = Foreign exchange rates.

Source: Adapted from BCBS 2021a.

## Box 1: The building blocks for physical risk assessment and transmission channels from Physical Risks to Financial Risks

The Intergovernmental Panel on Climate Change's (IPCC) definition of risk provides a strong foundation for physical risk assessment (Figure 3). It is a function of the probability of a given physical climate hazard occurring at a given magnitude, its dynamic interaction with the level of exposure, and the vulnerability of the effected human or ecological system (IPCC 2012; updated in 2014 and 2022). The level of exposure and vulnerability determines the impact of the physical risk, should the hazard occur. In this function, risks include the possible financial impact of physical hazards for an organisation. These three factors of risk—hazard, exposure, and vulnerability—are essential building blocks for assessing physical risk and its impact.

**Figure 3: Physical climate risk as a function of hazard, exposure, and vulnerability**



Note: GHG = Greenhouse gas.

Source: Viner et al. 2020.

These physical risks then impact businesses and financial institutions in the form of financial risks, and it is these risks that the TCFD framework aims to identify and quantify. Physical risks can manifest as financial risks through one of two main transmission channels:

1. **Top-down macroeconomic impacts:** These are the aggregate impacts on the wider economy as a result of price shifts (due to supply shocks, large-scale shifts in demand); productivity changes due to temperature increases or water stress; diversion of finance to adaptation/disaster response; socio-economic impacts due to migration, conflict, labour market impacts; and impacts on other macroeconomic indicators including trade, government revenues, interest rates, exchange rates, etc.
2. **Bottom-up microeconomic impacts:** These are the impacts at the household, asset, or organisation level by direct damage to property or people. Indirectly, physical climate risks may also change the demand for certain products or disrupt supply chains reducing the supply of crucial inputs.

Physical risks are then translated into business-level financial risks, via these transmission pathways:

|                          |  |
|--------------------------|--|
| <b>Credit risk</b>       | Defaults on loans by businesses and households   |
| <b>Market risk</b>       | Price changes to loans, commodities, equities, fixed-income products   |
| <b>Underwriting risk</b> | Increased insurance costs/losses   |
| <b>Operational risk</b>  | Potential for damage or closure to business assets or supply chain disruption  |
| <b>Liquidity risk</b>    | Higher demand for liquidity and refinancing  |
| <b>Litigation risk</b>   | Increased risk of legal action from clients due to failure to anticipate risks or to respond to climate-related disruption |

## 1.2 Supervisory and regulatory action

In the years following the publication of the recommendations of the TCFD, a number of jurisdictions have mandated climate-related disclosures for publicly listed corporates and financial institutions, or are setting out a pathway towards mandatory disclosure.<sup>5</sup> It has become increasingly clear that voluntary frameworks will not lead to uniform market-wide disclosure of information on climate-related physical risks. Furthermore, climate disclosures can vary substantially in quality and depth. Given these challenges, the need for economy-wide, high-quality climate-related risk disclosures is becoming clear. More globally coordinated regulatory is needed to set the standard and quality of climate risk assessments.

<sup>5</sup> including in Brazil, Canada, the European Union, Hong Kong, New Zealand, Singapore, Switzerland, the United Kingdom, and the United States of America.

Appendix A provides highlights of regulations in the European Union, the United Kingdom, and proposals in the United States of America, as well as an overview of how physical risks are considered in the International Sustainability Standards Board's (ISSB) Exposure Draft of its proposed Climate-related disclosures.

## 1.3 UNEP FI and the TCFD

The United Nations Environment Programme Finance Initiative (UNEP FI) has been working with over 100 financial institutions from across banking, investment investing, and insurance since 2018 to pilot the recommendations of the TCFD,<sup>6</sup> developing physical risk guidance for banks and investors with Acclimatise (UNEP FI 2018; UNEP FI 2020) and Vivid Economics (UNEP FI 2019a). In parallel, UNEP FI worked with the Global Commission on Adaptation to identify the barriers to accelerating adaptation finance (2019b), which highlighted the importance of assessing and disclosing physical climate-related risks.

Consequently, UNEP FI convened 10 financial institutions at the Climate Adaptation Summit in January 2021, to commit to publishing climate-related physical risk disclosures in line with the TCFD (UNEP FI 2021). In committing to disclose their risk from the physical impacts of climate change, these 10 financial institutions raised the following questions concerning the characteristics of good quality disclosures of physical climate-related risks:

- What are financial institutions currently disclosing in their climate risk reports?
- What does the current availability and quality of data, and methodologies, allow financial institutions to disclose?
- What are financial regulators and supervisors expecting of climate-related disclosures by financial institutions?
- What will good practice look like in the short to medium term, that is, in 2–3 years?

This guide has been developed by UNEP FI and the World Resources Institute (WRI) in response to these questions, building on some of the guidance material developed over the past four years, surveys of best practice by UNEP FI members, and discussions with financial institutions from across the finance sector.

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6 [unepfi.org/climate-change/tcfd/](https://unepfi.org/climate-change/tcfd/).



# 1. About this report

The 2017 TCFD recommendations set out seven principles for institutions to develop high-quality and decision-useful climate-related financial disclosures. The TCFD recommends that disclosures should be, as follows:

- Focused on providing relevant information
- Specific and complete
- Clear, balanced, and understandable
- Consistent over time
- Comparable among organisations within a sector, industry, or portfolio
- Reliable, verifiable, and objective
- Provided on a timely basis

The aim of this report is to provide a resource for financial institutions in the development of physical climate risk disclosures aligned with the above TCFD principles. The report covers three of the four TCFD thematic areas—Strategy, Risk Management, and Metrics and Targets—and eight of the eleven recommended disclosures ([Table 1](#)). It *does not* include recommendations under the following:

- The **Governance** thematic areas, because Governance does not cover physical or transition risks specifically, but rather overall climate-related risks.
- The **second recommended disclosure of the Metrics and Targets** thematic area, which concerns greenhouse gas emissions and is therefore not relevant for physical risks.



**Table 1: TCFD recommendations, recommended disclosures, and their coverage in the report**

| Recommendations            | Recommended disclosures   | Covered by the report? |
|----------------------------|---|------------------------|
| <b>Governance</b>          | a. Describe the board’s oversight of climate-related risks and opportunities  | No                     |
|                            | b. Describe management’s role in assessing and managing climate-related risks and opportunities   | No                     |
| <b>Strategy</b>            | a. Describe the climate-related risks and opportunities the organisation has identified over the short, medium, and long terms                              | Yes                    |
|                            | b. Describe the impact of climate-related risks and opportunities on the organisation’s businesses, strategy, and financial planning                        | Yes                    |
|                            | c. Describe the resilience of the organisation’s strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario | Yes                    |
| <b>Risk Management</b>     | a. Describe the organisation’s processes for identifying and assessing climate-related risks  | Yes                    |
|                            | b. Describe the organisation’s processes for managing climate-related risks   | Yes                    |
|                            | c. Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organisation’s overall risk management     | Yes                    |
| <b>Metrics and Targets</b> | a. Disclose the metrics used by the organisation to assess climate-related risks and opportunities in line with its strategy and risk management process    | Yes                    |
|                            | b. Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks  | No                     |
|                            | c. Describe the targets used by the organisation to manage climate-related risks and opportunities, and performance against targets                         | Yes                    |

Source: TCFD 2017

Section 2: presents the methodology used for identifying good practices in climate-related physical risk disclosures, including the review of disclosures by selected financial institutions.

Section 3: presents the findings of the review.

Section 4: presents the physical risk disclosure guidance for each of the TCFD-recommended disclosures. Section 5 concludes and discusses areas for further work.

# 1.1 Methodology

The authors of this report used three different methods to identify current good practices and to develop guidance in the disclosure of physical climate risks according to the TCFD recommendations, including (1) desk research; (2) engagement with financial institutions through webinars, a survey, and a workshop;<sup>7</sup> and (3) a review of publicly available disclosures by banks and asset owners.

## Desk research

Preliminary insights were first gained from a review of risk disclosure standards and regulations, and second, from practitioners in the financial industry during a series of webinars from September to December 2021, and subsequently through a survey questionnaire and an expert workshop.

## Engagement through webinars, survey, workshop

The webinars and the workshop allowed the authors to get direct feedback from financial institutions, though the limited number of financial institutions identified restricted the breadth of feedback and opinions. Webinar and workshop participants skewed towards banks, given UNEP FI's membership, though some investors did join these sessions. We also reviewed a relatively small sample of climate risk disclosures by asset owners (including insurers), as described below. Despite the focus on banks, this report does provide a unique perspective for analysing physical risk management and disclosure. Banks have diverse clients from across the economy, mature financial risk management practices, and better access to data from their clients to measure physical risk.

## Review of physical risk disclosures

In addition, in identifying good practice in the disclosure of climate-related physical risks by financial organisations, the authors conducted a review of climate-related risk reports by a sample of financial institutions leading on climate change mitigation and net zero numbering 109 banking institutions and 71 asset owners as of 31 April 2022. Although this sample is skewed towards financial institutions that are more likely to manage transition risks because of their net-zero commitments, they are also more likely to have comprehensive climate-related risk disclosures. Such disclosures should include both transition and physical risks. Without a global list or initiative for identifying financial institutions with comprehensive physical risk disclosures, we chose a sample of globally diverse financial institutions with a focus on net-zero targets for this review that are more likely to disclose physical risks. Of these 180 institutions, 82—that is, 57 banks and 25 investors—were identified as having published climate-related risk disclosures with some assessment of physical risks, that is, almost half of the sample. We took examples from higher-quality disclosures as case studies in this report.

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<sup>7</sup> Webinars included presentations by guest speakers on certain physical risk topics, followed by limited discussion. The workshop was a session where participants shared their experience of physical risk disclosures based on survey results. The workshop did not have a presentation by guest speakers.

Disclosure reports were assessed across 17 questions under eight of the eleven recommendations of the TCFD ([Table 2](#)). These questions are based on the TCFD's 2021 updated supplement, "Implementing the recommendations of the task force on climate-related disclosures" (TCFD 2021b). The two recommendations on Governance and the second recommendation on Metrics and Targets are not covered by this report. The Governance recommendations refer to general coverage of climate-related risks, both transition and physical, across the governance structure of an institution, while the recommended Metrics and Targets disclosure of Scope 1 to 3 emissions only concerns transition risks.

**Table 2: Physical risk disclosure assessment questions developed based on TCFD recommendations**

|                 |  |  |
|-----------------|--|--|
| <b>Strategy</b> | <p><b>a.</b> Describe the climate-related risks and opportunities the organisation has identified over the short, medium, and long terms.</p>                              | <p><b>S.a1</b> What does the company consider as relevant short-, medium-, and long-term time horizons, taking into consideration the useful life of its assets or infrastructure and the fact that climate-related issues often manifest themselves over the medium and longer terms?</p>   |
|                 |  | <p><b>S.a2</b> What are the specific climate-related issues for each time horizon (short, medium, and long term) that could have a material financial impact on the organisation?</p>  |
|                 |  | <p><b>S.a3</b> What are the company's risks and opportunities disaggregated by sector and/or geography?</p>  |
|                 | <p><b>b.</b> Describe the impact of climate-related risks and opportunities on the organisation's businesses, strategy, and financial planning.</p>                        | <p><b>S.b1</b> What is the impact of climate-related physical risks and opportunities on the company's businesses and strategy (e.g., on its products and/or services, supply and value chains, adaptation and mitigation activities, R&amp;D investment, operations)?</p>   |
|                 |  | <p><b>S.b2</b> How do identified climate-related physical risks and opportunities affect and serve as an input to the company's financial planning process? What are the time period(s) used, and how does the organisation prioritise these risks and opportunities?</p>  |
|                 |  | <p><b>S.b3</b> What is the impact of climate-related physical risks and opportunities on the organisation's financial planning in terms of operating costs and revenues, capital expenditures and capital allocation, acquisitions/divestments, and access to capital?</p>   |
|                 | <p><b>c.</b> Describe the resilience of the organisation's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.</p> | <p><b>S.c1</b> What are the climate-related scenarios and associated time horizon(s) considered by the organisation?</p>   |
|                 |  | <p><b>S.c2</b> How resilient are the company's strategies to climate-related physical risks and opportunities, taking into consideration, where relevant to the company, scenarios consistent with increased physical climate-related risks?</p> <ul style="list-style-type: none"> <li>▪ How might strategies be affected by climate-related risks and opportunities?</li> <li>▪ How might these strategies evolve to address climate-related risks and opportunities?</li> </ul> |

|                     |   |   |
|---------------------|---|---|
| Risk management     | a. Describe the organisation's processes for identifying and assessing climate-related risks.   | <b>R.a1</b> What is the organisation's process for assessing the potential size and scope of identified climate-related physical risks? Describe any risk classification frameworks used.   |
|                     |   | <b>R.a2</b> How does the organisation determine the relative significance of climate-related risks in relation to other risks? Banks should characterise these risks in the context of credit, market, liquidity, and operational risks.                                    |
|                     |   | <b>R.a3</b> Does the organisation consider existing and emerging regulatory requirements related to climate change (e.g., flood risk management, water usage) or other relevant factors?  |
|                     | b. Describe the organisation's processes for managing climate-related risks.  | <b>R.b1</b> How does the organisation make decisions to mitigate, transfer, accept, or control climate-related physical risks? What are the processes for prioritising climate-related risks, including determinations of materiality (address risks in TCFD Tables A1, A2) |
|                     | c. Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organisation's overall risk management.  | <b>R.c1</b> Is the organisation's approach to managing climate-related physical risks integrated into a broader risk management programme? If so, how?  |
| Metrics and targets | a. Disclose the metrics used by the organisation to assess climate-related risks and opportunities in line with its strategy and risk management process. | <b>M.a1</b> Which performance metrics does the company use to assess and manage financially material climate-related physical risks and opportunities, such as those related to water, energy, land use, and waste management?  |
|                     |   | <b>M.a2</b> Are the methodologies used to calculate or estimate climate-related physical impact metrics clear?  |
|                     |   | <b>M.a3</b> Do the metrics and targets disclosed provide historical trends and forward-looking projections (by relevant country and/or jurisdiction, business line, or asset type)?   |
|                     | b. Describe the targets used by the organisation to manage climate-related risks and opportunities, and performance against targets.                      | <b>M.c1</b> Has the company established and communicated climate-related performance targets in line with anticipated regulatory requirements, market constraints, or other goals, such as operational or financial objectives or loss tolerances?                          |

Notes: R&D = Research and development.

Source: Authors based on TCFD 2021b.

The 82 disclosures were scored according to their responsiveness to these questions using the below grades from 0 to 3:

| Marking scale   |       |
|---|-------|
| Scoresheet  | Grade |
| No information provided   | 0     |
| Generic information, and only partial response/in planning                      | 1     |
| Complete and qualitative information, following TCFD principles (see section 2) | 2     |
| Good practice, quantitative information   | 3     |

The sample size of the review could have been further expanded using natural language processing or other artificial intelligence (AI) techniques capable of assessing the quality of physical climate risk disclosures. Climate-related financial disclosures by companies are in an early stage of development with significant variations of language and semantics used to describe a particular disclosure issue across countries, sectors, and even companies in the same sector. Physical risks and opportunities disclosures are less common and mature than those of transition risks and opportunities (TCFD 2021a). The goal of the literature review is to identify current good practices in existing disclosures. However, even sophisticated AI is not able to assess the quality of disclosures and can only determine whether a company's disclosure aligns with standardised language, such as the TCFD recommendations. Nuanced assessment of disclosures requires direct reading and analysis, even if this limits the number of disclosures included in the review.

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## 2. Findings of physical risk disclosures review

### 2.1 Key findings

The key takeaways from this qualitative assessment of 57 banks' and 25 investors' physical risk disclosures are, as follows:

- **Disclosure of physical risks is still very much in its infancy**, with no reports responding fully to the TCFD's recommendations in terms of assessing risks from the physical impacts of climate change.
- The majority of disclosures respond at least partially to the first Strategy and first Risk Management recommendations, that is, **institutions are defining time horizons and setting out a process for identifying and assessing physical climate risks**.
- The next best response is to the third Strategy recommendation, showing that once a high-level assessment of sector or geographical vulnerability to physical impacts has been made, financial institutions carry out some form of scenario analysis, though usually limited to one sector and one to three physical climate hazards, for example, the impact of flooding on the real estate sector in the lending or investing portfolio. **Currently only around 23% of banks' and 24% of investors' disclosure reports from our sample with some analysis of physical risk include scenario analysis.**<sup>8</sup>
- The **majority of scenario analyses have been carried out by banks on mortgage or real estate portfolios**, where banks have ready access to location data—22 of the 57 banks' disclosure reports reviewed included an analysis of impacts on the real estate/mortgage sector. **Only 7 out of the 57 disclosure reports by banks with some analysis of physical risk have carried out scenario analysis on more than one sector.**
- **The most common hazard covered by these analyses is flooding** (coastal and/or fluvial) with high granularity flood maps being publicly available in most of Europe, North America, Australia, and East Asia (28 reports). Location-specific hazards are also important, such as subsidence in the United Kingdom (three reports), and wildfire in South Africa (one report). In almost all cases, flood risks were assessed for the real estate/mortgage sector or for operational risks, that is, flood risks to corporate assets. The exceptions were two banks that applied flood risk analysis to "all corporate clients" and another that was not clear on the sectors, geographies, or clients to which its scenario analysis was applied.

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<sup>8</sup> Assuming a score of 2 or 3 for question S.c1.

- Quantitative metrics are used in 32 disclosures covering physical risks (42%), published by banks and investors.** The majority of these were metrics used to describe physical hazards, such as probabilities or return periods in the case of flooding, or exposure metrics to describe the number of properties exposed to flooding, for example. **Only seven disclosure reports estimated financial risk metrics**, such as Estimated Credit Losses (ECLs) or percentage change in Loan-to-Value (LV) ratios. Only one bank was confident enough to estimate a financial target (percentage exposure) in the Metrics and Targets section of its report.

Ideally, a balanced, comprehensive climate-related risk disclosure report should address both transition and physical risks simultaneously (UNEP FI and CISL 2022). This assessment should preferably be based around a common set of scenarios from which both transition and physical risk assessments can be made, such as the NGFS set of scenarios, in order to evaluate climate-related risks holistically for each potential climate pathway. However, a number of factors including resource limitations, data quality and availability, modelling uncertainties, greater knowledge of specific transition and physical risk methodologies result in disclosures that currently either focus solely on transition risks or include physical risk assessments that are methodologically independent of the transition risk assessments—often focusing on sectors that are especially vulnerable to either risk.

The disclosure review shows that banks are responding better to the first Strategy and the first Risk Management recommendations, followed closely by initial steps in scenario analysis, the third Strategy recommendation—at least in defining the scenarios, sectors, and physical hazards to be addressed in such an analysis. This suggests that financial institutions may be approaching their climate-related risk assessments by tackling these elements first, following a possible workflow, as in [Figure 4](#) below. Through an iterative process this should improve the quality of disclosures over time.

**Figure 4: Climate-related risk assessment workflow**



Source: Authors



Overall, it is particularly noticeable that banks have developed more responsive physical risk disclosures than asset owners. However, there is hidden context behind these charts. No one bank has fully assessed physical risks across its portfolio in detail—we have awarded high marks for a quantitative assessment of a limited set of physical hazards, and in many cases only one physical hazard, across one sector, provided that a qualitative assessment of risk “hotspots” has been carried out for the wider portfolio. The most obvious sector for retail banks is to assess flood risks (fluvial, pluvial, coastal) across their commercial and retail mortgage books, given that banks will have direct access to property location data, and flood data are readily available from government river or environmental agencies. Furthermore, mortgages tend to have longer tenors than most other loans, making physical risk assessment more worthwhile, given the perceived longer-term materiality of physical climate risks. Asset owners, on the other hand, can only base their physical risk assessments either on generic top-down assessments of sector-level or region-level risks or develop assessments based on information from clients, which, given the low level of disclosure across companies, will take some time. Information from asset owners tends to be concentrated across the asset management arms of insurers and reinsurers, given their greater access to first-hand historic, and increasingly forward-looking estimates of, extreme event information.

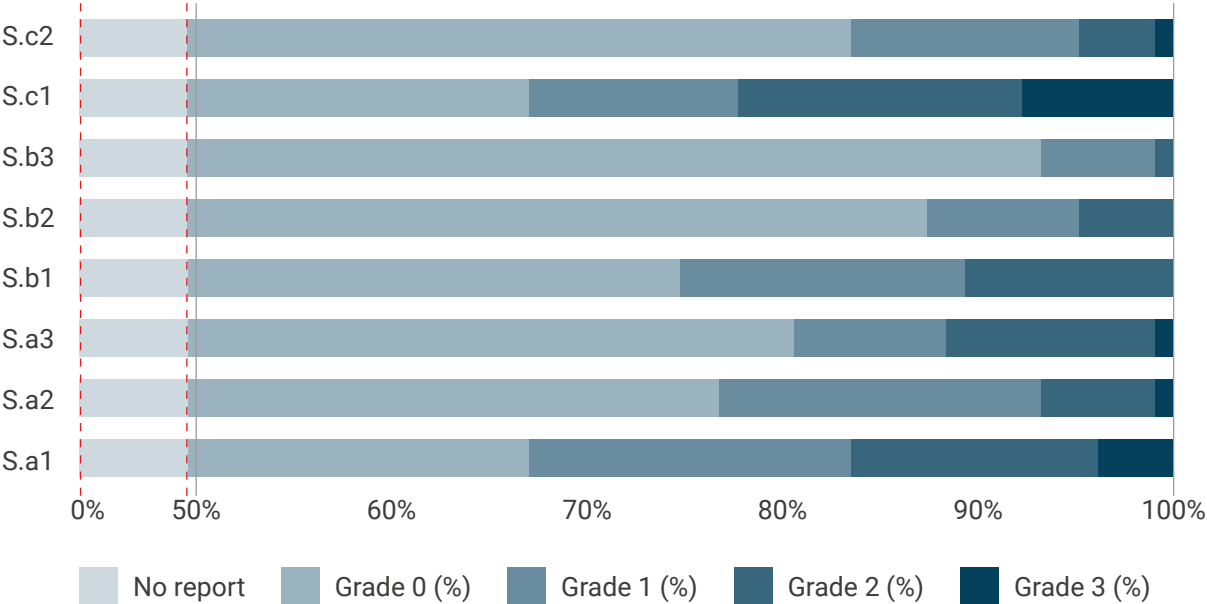
## 2.2 Bank disclosure review

Banks perform moderately better than the other investors in the disclosure of physical risks, with just over half of banks reporting on physical climate risks to some extent. However, these disclosures tend to be representative of banks located in jurisdictions where climate risk disclosure regulations are in place and data on certain climate hazards and certain assets are readily available. Banks demonstrating good practice in aspects of their disclosures also tend to be larger banks with adequate capacity and access to financial resources. This section provides deeper insight into the review of a sample of bank disclosures across each of the TCFD’s recommended disclosure areas.

Note that 48% of the sample of banks’ climate-related disclosure reports did not provide any review of physical risks at all. Figures 5, 6, 7 reflect this by focusing on the 52% of reports that did provide some information on physical risks (57 reports out of 109). The percentage data used in these graphs is given in Appendix C.

## 2.2.1 Strategy

**Figure 5: Grading of banks’ disclosure reports in response to strategy-related questions**



**Source: Authors** | For definitions please refer to [Table 2](#) (p.11 & 12)

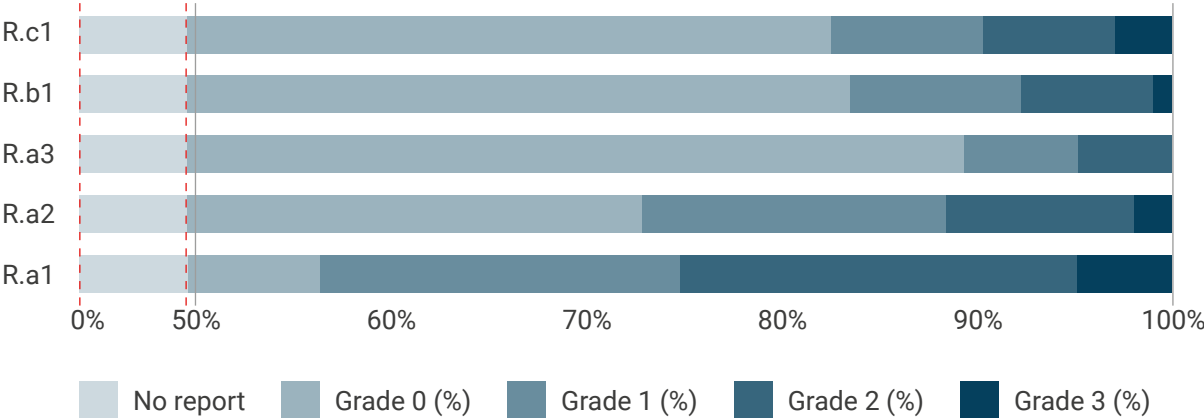
The review of the Strategy sections of banks’ disclosure reports shows that more than half of those reports give time horizons for identifying risks and opportunities (**S.a1**), but have not differentiated between time horizons for identifying physical risks as opposed to transition risks, let alone identified the specific impacts at different time horizons (**S.a2**) (see [Figure 5](#)). Banks tend to base their strategy in line with the average tenors of their loan book, rather than using time horizons over which significant physical risks are currently estimated to materialise. Fewer disclosure reports identify specific hazards and the risks or opportunities per sector and geography (**S.a3**). A qualitative evaluation of the potential impacts of physical hazards on the main sectors and geographies of a bank’s lending portfolio should be the minimum level of physical risk disclosures. Over time, regulators should ensure that minimum standards include a quantitative assessments of risks.

Impacts on the organisation’s business, strategy, and financial planning are identified in a general way by around half of the disclosure reports, but no banks meet the top score against question **S.b1**. In terms of financial planning, banks are even less responsive (**S.b2**, **S.b3**), though estimation of forward-looking financial impacts is currently difficult and prone to significant error (see Section 3.4.1). Just seven banks provided quantitative estimates of potential financial losses in one sector from one hazard.

Over half of banks disclosing physical risks have started working on scenario analysis of some form, providing information on scenarios and time horizons used, with almost 45% of those banks scoring 2 or 3 on question **S.c1**, providing qualitative or quantitative information on methodologies and outputs in line with the recommendations of the TCFD. Fewer banks, less than 5% of all sampled banks, are then assessing the implications of scenario analysis for their business strategies (five reports in total scoring 2 or 3 on question **S.c2**).

## 2.2.2 Risk Management

**Figure 6: Grading of banks’ disclosure reports in response to Risk Management-related questions**



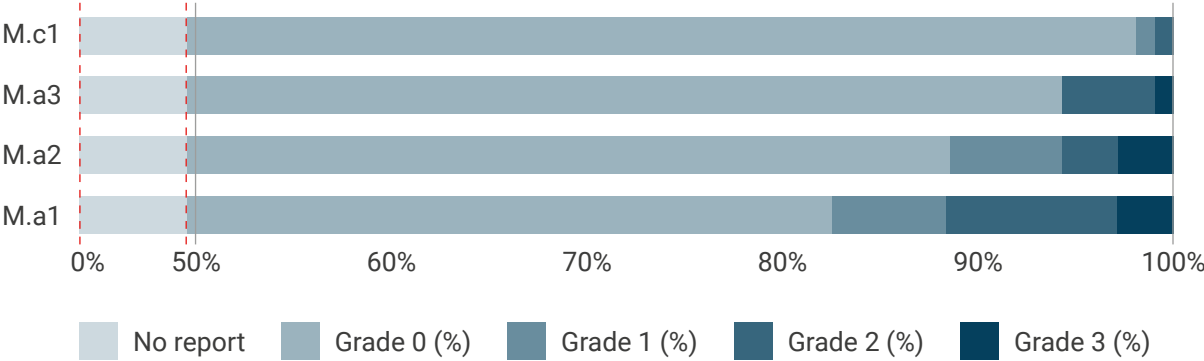
Source: Authors | For definitions please refer to [Table 2](#) (p.11 & 12)

The first question under the first Risk Management disclosure (**R.a1**) is best responded to by the banks, setting out processes for identifying risks; however, only half of banks reporting on physical risks provide complete and qualitative information (see [Figure 6](#)). Around half of the banks reporting on physical climate risks have mapped how these risks map onto banking risks (**R.a2**), with just 10% providing more than just generic information (scoring 2 or 3 on question **R.a2**). Very few banks—just five—have identified relevant regulations relating to physical risks, for example, water management, land use planning, and flood management regulations that could affect their clients, though this may only be possible if client engagement in relation to climate change becomes more sophisticated (**R.a3**).

Fewer than 10% of all banks sampled have disclosed, beyond a generic description, how they are managing physical risks (scoring 2 or 3 on question **R.b1**) and integrating them into their risk management systems (scoring 2 or 3 on question **R.c1**).

## 2.2.3 Metrics and Targets

**Figure 7: Grading of banks’ disclosure reports in response to Metrics & Targets related questions**



Source: Authors | For definitions please refer to [Table 2](#) (p.11 & 12)

The Metrics and Targets area of the TCFD recommendations is the least well-responded to across the board (see [Figure 7](#)). Just over 10% of banks are providing complete information on the types of metrics they are using to measure physical risks (**M.a1**). Far fewer are providing clarity on how these metrics are estimated (**M.a2**) and how trends are developing over time, or describing how they might monitor trends (**M.a3**). In terms of the types of metrics institutions are disclosing, only 20 of the sampled banks refer to a relevant physical risk metric, and most of these are metrics focused on the physical hazard itself, for example, percentage probabilities or return periods for fluvial or coastal flooding. Only eight of these disclosures then integrate vulnerability and exposure by estimating the number of assets (properties in the case of flooding impacts on a real estate or mortgage portfolio) or percentage of a sector at risk. Seven disclosures then provide a financial metric in the form of an Estimated Credit Loss (ECL) or climate-adjusted Loan-to-Value (LV) ratio. In the case of the most common physical impact assessed—flooding impacts on real estate—there is wide variation in the modelling parameters, such as return period, whether forward-looking scenarios have been incorporated, and the granularity of assessment and the damage function for calculating financial risk metrics. Transparency of inputs, modelling parameters, and methodologies are poor, thus reducing the comparability and usefulness of these disclosures.

Understandably, with such a dearth of information on metrics, only one bank has identified a target, and even then, it is a qualitative target to reduce its headline exposure to physical risks.

As can be seen from the below two tables, physical risk assessments including scenario analyses were heavily skewed towards real estate, with only a few analyses also covering other sectors (see [Table 3](#)). This is due to the relative ease with which banks are able to conduct risk assessments in this sector, given ready access to location data. Analyses of risks to real estate assets are mostly carried out against flooding hazards (pluvial, fluvial, and coastal), with an occasional second or third hazard assessed according to context—subsidence in the clay regions of southeast England or wildfires and storms in North America (see [Table 4](#)). Note that the disaggregation of hazards and geographies is not straightforward given that some reports provide detail on specific physical hazards analysed for specific lines of business, while others provide less specific information on the geographies covered and the assets assessed.

**Table 3: Banks’ disclosure review: industry segments & business lines covered by risk analyses**

|     | Mortgages | Commercial real estate | Agriculture | Energy / Utilities | Metals & mining | Transport | Oil & gas | Chemicals | Sovereign |
|-----|-----------|------------------------|-------------|--------------------|-----------------|-----------|-----------|-----------|-----------|
| No. | 22        | 2                      | 3           | 3                  | 2               | 1         | 1         | 1         | 2         |

Source: Authors

**Table 4: Banks' disclosure review: hazards & geographies covered by risk analyses**

|                          | Flood     | Subsidence | Drought/<br>water<br>stress | Coastal<br>erosion/<br>landslide | Wildfire | Extreme<br>precipitation | Extreme<br>weather | Extreme<br>heat | Extreme<br>cold/Ice | Sea-level<br>rise | Permafrost<br>degradation |
|--------------------------|-----------|------------|-----------------------------|----------------------------------|----------|--------------------------|--------------------|-----------------|---------------------|-------------------|---------------------------|
| Australia                | 1         |            | 1                           |                                  | 2        | 1                        | 1                  | 1               |                     | 1                 |                           |
| Canada                   | 1         |            |                             |                                  | 1        |                          |                    |                 | 1                   |                   |                           |
| EU, incl. NO & CH        | 13        |            | 2                           | 2                                | 2        |                          | 4                  | 1               | 1                   |                   |                           |
| Hong Kong                | 2         |            |                             |                                  |          |                          |                    |                 |                     |                   |                           |
| Japan                    | 3         |            |                             |                                  |          | 1                        | 2                  | 1               |                     | 1                 |                           |
| Korea                    | 1         |            |                             | 1                                |          | 1                        |                    |                 |                     |                   |                           |
| Mexico                   | 1         |            |                             |                                  | 1        | 1                        | 1                  | 1               |                     |                   |                           |
| Russia                   |           |            |                             |                                  | 1        |                          | 1                  |                 |                     | 1                 | 1                         |
| South Africa             | 1         |            |                             |                                  | 1        |                          |                    | 1               |                     |                   |                           |
| UK                       | 8         | 3          |                             |                                  |          |                          | 1                  |                 |                     |                   |                           |
| USA                      | 6         |            | 1                           |                                  | 1        | 2                        | 2                  | 2               |                     | 1                 |                           |
| <b>"Global"</b>          | <b>1</b>  |            | <b>1</b>                    |                                  | <b>1</b> |                          | <b>1</b>           |                 |                     | <b>1</b>          |                           |
| <b>Total<sup>a</sup></b> | <b>29</b> | <b>3</b>   | <b>5</b>                    | <b>3</b>                         | <b>8</b> | <b>5</b>                 | <b>9</b>           | <b>5</b>        | <b>2</b>            | <b>3</b>          | <b>1</b>                  |

**Source: Authors**

Notes: EU = European Union; NO = Norway; CH = Switzerland.

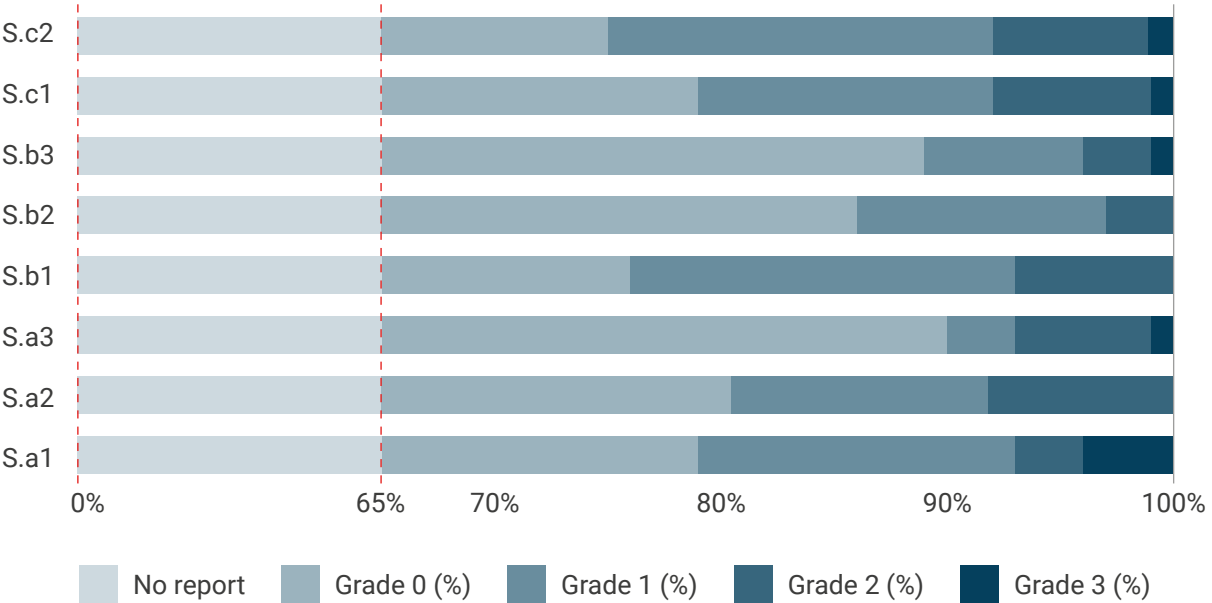
a. Note that some disclosures may cover more than one geography, so the total number of disclosures may not equal the number of disclosures in each geography.

## 2.3 Investor disclosure review

Asset owners in general lag behind banks regarding physical risk disclosures, as only 35% of the sampled investors have physical risk disclosures on any of the three pillars of the TCFD recommendations (25 reports out of 71). Different types of investors were sampled, including (re)insurance companies, pension plans, endowments, and sovereign wealth funds. Some of the signatories are not publicly listed companies and may not have existing extensive disclosure obligations. As a result, the percentage of investors with climate-related disclosures is smaller than the percentage of banks, most of which are publicly listed. Given that 65% of investor climate-related disclosure reports did not provide any review of physical risks at all, Figures 7, 8, 9 reflect this by focusing on the 35% of reports that did provide some information on physical risks. The percentage data used in these Figures is given in Appendix C.

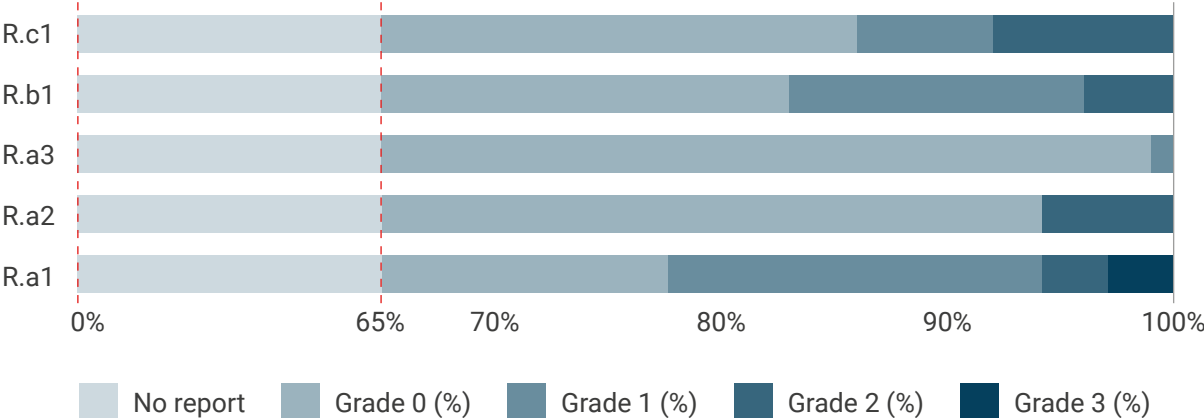
Among the three pillars of the TCFD recommendations, the Strategy pillar is best responded to, while the Metrics and Targets thematic area receives the fewest responses (Figure 8, Figure 9, and Figure 10). (Re)insurance companies (excluding life insurance) provided more comprehensive and detailed physical risk disclosures than other types of investors. Most of these disclosures focused on their underwriting business where physical risks can have significant impacts. However, physical risk disclosures related to the assets they own are very rare.

**Figure 8: Grading of investor disclosure reports in response to Strategy-related questions**



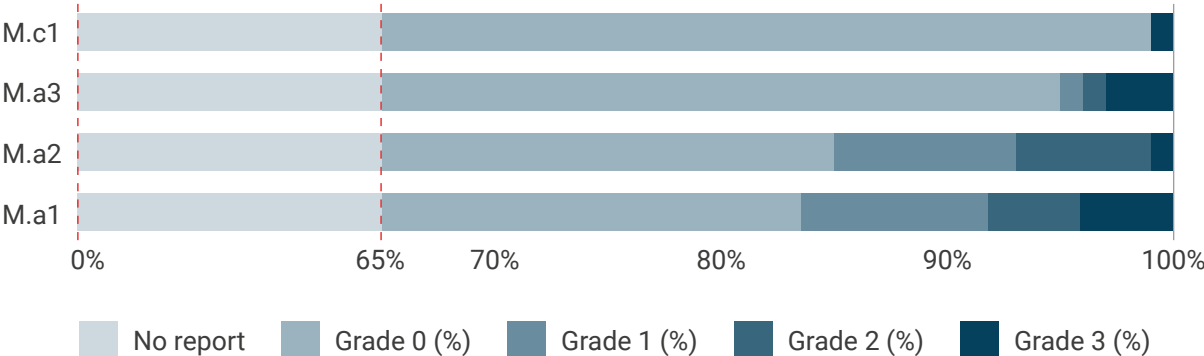
Source: Authors | For definitions please refer to Table 2 (p.11 & 12)

**Figure 9: Grading of investor disclosure reports in response to Risk Management-related questions**



Source: Authors | For definitions please refer to [Table 2](#) (p.11 & 12)

**Figure 10: Grading of investor disclosure reports in response to Metrics and Targets-related questions**



Source: Authors | For definitions please refer to [Table 2](#) (p.11 & 12)

### 3. Physical risk disclosure guidance in line with the TCFD Recommendations

This section proposes guidance for financial institutions on each of the TCFD-recommended disclosures—Strategy, Risk Management, and Metrics and Targets—and a short section follows with how physical risks should be considered in a report’s introduction. This guidance addresses the following:

- **Base-level disclosures:** These cover points that all disclosures should aim to address as a baseline. These were prevalent in existing TCFD disclosures the authors reviewed and those that are required by regulators and standard-setters. Regulatory requirements may vary between jurisdictions.
- **Next-level disclosures:** These are currently possible given data availability, knowledge, and methodologies; examples of which may be available in the most comprehensive disclosures.
- **Further considerations:** These are what financial institutions should take into account as they assess and disclose physical risks, in areas which are developing rapidly and for which there is no widely accepted standard. These open questions include what may currently be very challenging for most financial institutions but is likely to be possible in the next three years, assuming access to open-source data, more granular climate scenarios, greater capacity and knowledge, and the roll-out of international standards and mandates.

It is worth noting that the workflow for identifying, assessing, reporting, and monitoring climate-related risks may vary between financial institutions. The framework of the TCFD covers four thematic areas: Governance, Strategy, Risk Management, and Metrics and Targets, but this may not necessarily reflect an institution’s process for assessing and managing climate-related risks. Other climate disclosure frameworks may group these thematic areas differently while covering the same recommendations. This can be seen in the European Commission’s “Guidelines on reporting climate-related information” (EC 2019), whose five key areas of disclosure can be mapped onto the recommendations of the TCFD, though not in the same order or themes.



## 3.1 Introduction to a TCFD disclosure

Before addressing the TCFD’s recommendations, disclosures should provide an overview of responses to the recommended disclosures in their introductions, setting out the following:

- The general approach to identifying, assessing, and reporting on climate-related risk, with a particular focus on how the report intends to address transition risks and physical risks—whether simultaneously, or separately or integrated, and the reasons for doing so.
- Ideally, a roadmap for developing and improving disclosures in the short to medium term, with the goals of scaling geographical and sector coverage, and increasingly aligning physical and transition risk assessments around common scenarios.
- Summary of the processes and methodology of the present disclosure report, including an overview of key outcomes, metrics, and targets.

Given that the recommendations of the TCFD are mainstream and widespread and the International Sustainability Standards Board’ (ISSB) prototype disclosure framework maps very closely onto the TCFD recommendations—with some important, though not fundamental differences (IFRS 2022)—then the introduction to the disclosure should also provide a mapping of these recommendations onto relevant sections of the report, especially if the body of the report is not disaggregated into the specific TCFD or ISSB headings, or is part of a wider report (e.g., climate, nonfinancial, annual report).

### Box 2: Scoping physical risks

In measuring transition risks, financial institutions are asked to report in line with the Greenhouse Gas (GHG) Protocol. The Protocol defines direct and indirect sources of emissions according to three “scopes,” which can be defined as follows:

- Scope 1: Direct GHG emissions. These are the emissions over which a company has direct control, that is, the emissions generated by an institution’s own operations such as use of company-owned transport.
- Scope 2: Indirect GHG emissions. These are the emissions from purchased or acquired electricity, steam, heat, and cooling. In this case the institutions may have control over the consumption of energy, and some leverage over the method of generation—if, for example, they have a renewable energy contract, but do not generate the emissions themselves.
- Scope 3: Other indirect GHG emissions. These are emissions as the result of activities from assets now owned or controlled by the company, but that the company indirectly impacts in its value chain. This can include some emissions pertinent to a company’s operations, such as employees’ travel, purchased goods, or materials and waste.

However, in a financial institution's case, the vast majority of Scope 3 emissions will be those produced by beneficiaries of the financial institution's products. A similar approach could be taken to physical risks. The following scopes would cover both acute and chronic risks:

- Scope 1 physical risks: Risk of hazards that directly impact a financial institution's operations, for example, flood risk to bank branches, hurricane risk to offices.
- Scope 2 physical risks: Hazards that indirectly impact a financial institution's operations, for example, extreme heat impacting transport systems bringing employees to work, flood risk to data centres.
- Scope 3 physical risks: Climate-related hazards impacting beneficiaries of a financial institution's products. As can be seen from the review of banks' disclosures, the majority of these assessments have looked at flood risks to a bank's mortgage portfolio, though some banks have looked at risks associated with a range of climate-related physical hazards such as water stress on agricultural firms, extreme weather and sea-level rise on electricity generation, to name just a few examples.

## 3.2 Strategy

The objective of the TCFD Strategy recommendations is to inform investors and other stakeholders on how climate-related risks and opportunities may affect a financial institution's business, strategy, and financial planning over different time horizons. For physical risks and opportunities, disclosures should address how physical hazards are identified; their actual financial impacts on financial institutions; and their potential financial impacts, which can be informed by climate-related scenarios. It is also important to include an assessment of the resilience of a financial institution's strategy to physical risks and how flexible it is to take advantage of potential climate-related opportunities.

Current strategy-related disclosures for physical risks are not prevalent and often not comprehensive, even if such disclosures are available. They vary greatly with respect to completeness and quantitative information according to the review of bank and investor disclosures. Compared to transition risks and opportunities, physical risk disclosures have significant room for improvement in terms of consistency and comparability, which can ultimately make those disclosures more decision-useful. Box 3 provides a list of physical hazards identified in the IPCC AR6, which can serve as the basis for hazard identification.








While most disclosures by (re)insurance companies provide comprehensive and quantitative physical risks disclosures for their underwriting business, many disclosures by other types of financial institutions only provide very high-level and general overviews of physical risks without identifying specific physical hazards or associated time horizons.

A few banks give physical risk disclosures focusing on mortgages, real estate, and agriculture lending, which are among the most vulnerable sectors to physical impacts. The loan maturity of these sectors can be decades in the future and is often longer than for other sectors. These factors can be part of the reason that these sectors receive more emphasis from banks in terms of physical risk disclosures than do other sectors and have better data and methodologies available.

**Box 3: Climate-related physical hazards**

For the first time, the IPCC Sixth Assessment Report (AR6), Working Group I: Climate Change 2021: The Physical Science Basis (IPCC 2021), develops a comprehensive list of 35 physical climate hazards, grouped into seven categories: heat and cold; wet and dry; wind; snow and ice; coastal and oceanic; open ocean; and other (Figure 11). The long list of hazards does not mean that companies and financial institutions need to assess the impact of all those hazards on their business. However, disclosure of material risks is absolutely essential for understanding exposure to climate change impacts, and they should use this list as a reference to identify those risks that are material to their businesses and investments. Then they can conduct in-depth analysis for the actual and potential impacts of those hazards on their business, strategy, and financial planning.

**Figure 11: The 35 physical climate hazards in seven categories developed in the IPCC AR6 Working Group I report**

-  **Heat & Cold:** Mean surface temperature, extreme heat, cold spell, frost
-  **Wet & Dry:** Mean precipitation, river flood, heavy precipitation and pluvial flood, landslide, aridity, hydrological drought, agricultural and ecological drought, fire weather
-  **Wind:** Mean wind speed, severe wind storm, tropical cyclone, sand and dust storm
-  **Snow & Ice:** Snow, glacier and ice sheet, permafrost, lake and sea ice, heavy snowfall and ice storm, hail, snow avalanche
-  **Other:** Air pollution weather, atmospheric CO<sub>2</sub> at surface, radiation at surface
-  **Coastal & Oceanic:** Relative sea level, coastal flood, coastal erosion, marine heatwave, ocean acidity
-  **Open Ocean:** Mean ocean temperature, marine heatwave, ocean acidity, ocean salinity, dissolved oxygen

Source: IPCC 2021

### 3.2.1 Recommendation S.a: Describe the climate-related risks and opportunities the organisation has identified over the short, medium, and long terms

This recommended disclosure for physical risks should provide answers to the following three questions according to “Implementing the recommendations of TCFD” (TCFD 2021b):

- What are the relevant short-, medium-, and long-term time horizons?
- What are material physical hazards or potential risks in each time horizon?
- What is the process used to determine those physical hazards or risks?

In describing physical hazards or risks, organisations should use two subcategories—acute and chronic—to describe those that are event-driven and long-term shifts in climate patterns, respectively. Physical hazards are not regionally uniform, and vulnerabilities to physical hazards vary from sector to sector. As a result, organisations should consider providing disclosures by geography and/or sector.

An organisation should consider the useful life of its assets, characteristics of its businesses, and the nature of physical climate hazards to decide the short-, medium-, and long-term time horizons. These time horizons should cover the duration of an asset’s lifetime or the lifetime of a financial instrument. For example, a bank should consider years to maturity of its loans in determining relevant time horizons.

In addition, there should be clear linkages between the different time horizons and an organisation’s businesses, strategy, financial planning, and risk management. The description should consider the fact that some physical climate hazards have already intensified and become more frequent while others may manifest over longer time horizons. Finally, regulatory guidance might specify time horizons. For instance, the EU Taxonomy specifies climate risk and vulnerability assessments to be carried out over a short time period for short-lived investments and 10–30 year climate projection scenarios for larger, more long-term investments (EC 2021).

| Strategy 1. Risk ID & time horizons |   |
|-------------------------------------|---|
| <b>Base-level disclosures</b>       | <p>Description of short-, medium-, and long-term time horizons, listing the specific durations. These are likely to vary for different institutions—for further support, check guidelines issued by the relevant supervisory or regulatory authority, including those of stress tests where time horizons are prescribed for physical risks.</p> <p>Description of material physical hazards or risks in each relevant time horizon across sectors with reference to key geographies and split into acute and chronic hazards or risks (see “Charting a New Climate,” UNEP FI 2020).</p> <p>Context on how time horizons and physical hazards or risks are determined with respect to business, risk management, or financial planning.</p> |
| <b>Next-level disclosures</b>       | <p>More granular description of material physical hazards or risks in each relevant time horizon by geography, sector, and/or business segment, as appropriate.</p> <p>Introducing the risk management and business planning and strategy aspects into the time horizons.</p>   |

|                               |   |
|-------------------------------|---|
| <b>Further considerations</b> | Should short-, medium-, and long-term time horizons be standardised for physical risks for companies in the same industry?<br>How should an organisation choose data with competing qualities and characteristics? For example, choose a source that is global but with lower spatial resolution, or choose sources that are national with higher spatial resolution but inconsistent across countries?   |
| <b>Examples</b>               | Figure B-1: Barclays PLC, <a href="#">Climate-related financial disclosures 2021</a> (p. 12)<br>Figure B-2: Lloyds Banking Group, <a href="#">Climate report 2021</a> (p. 14)<br>Figure B-3: European Bank for Reconstruction and Development, <a href="#">TCFD report 2020</a> (p. 16)<br>Figure B-4: Danske Bank, <a href="#">Climate and TCFD progress update</a> (pp. 23–24)<br>Figure B-5: Munich Re, <a href="#">Corporate responsibility report 2020</a> (p. 55) |

### 3.2.2 Recommendation S.b: Describe the impact of climate-related risks and opportunities on the organisation’s business, strategy, and financial planning

This recommended disclosure should discuss how physical hazards or risks have affected an organisation’s business, strategy, and financial planning, and should address the following questions.

- What is the actual impact of physical risks on business, strategy, and financial planning, such as in products and services, supply chain and/or value chain, and operations?
- How do physical risks serve as an input into the financial planning process?
- What is the actual impact of physical risks on financial performance (e.g., revenues, costs) and financial position (e.g., assets, liabilities)?

Some sectors or industries can be particularly vulnerable to physical climate change, such as (re)insurance companies that provide insurance cover against losses caused by physical hazards. These organisations should provide quantitative information on the potential impacts of physical hazards on core business, products, and services, where available.

| <b>Strategy 2. Business &amp; financial impact</b> |   |
|--|---|
| <b>Base-level disclosures</b>                      | Description of the potential impact of physical risks on business, strategy, and financial planning.<br>Description of whether and how exposures to physical risks have led to any changes in business, strategy, and financial planning.   |
| <b>Next-level disclosures</b>                      | Detailed and quantitative assessment of financial impacts from physical risks in most vulnerable business segments. Disclosures should also include data sources, methodologies, and an assessment on the reliability of these data sources.<br>Material analysis of different business segments/geographical regions/sectors against a comprehensive list of physical hazards, such results can be presented in a physical climate risk heatmap. |

|                               |   |
|-------------------------------|---|
| <b>Further considerations</b> | <p>How to assess accuracies of computed financial impacts from physical risks due to uncertainties in methodological assumptions and data?</p> <p>How to create consistent and comparable metrics for impacts of physical risks to better integrate into a financial institution’s business, strategy, and financial planning?</p> <p>Could physical risks have an impact on business continuity due to potential interruptions to their own operations?</p> <p>Should physical risk disclosures include potential impacts to a financial institution’s upstream and downstream value chains?</p> <p>How are financial impacts affected by multiple physical risks or physical risks combined with other risks such as public health, conflict, migration, etc.</p> |
| <b>Examples</b>               | <p>Figure B-6: BMO Financial Group, <a href="#">2020 Climate report</a> (p. 6)</p> <p>Figure B-7: Banco Santander, <a href="#">Climate finance report</a> (p. 10)</p> <p>Figure B-8: UBS, <a href="#">Climate report 2021</a> (p. 24)</p> <p>Figure B-9: Banco Santander, <a href="#">Climate finance report</a> (p. 20)</p> <p>Figure B-10: Barclays PLC, <a href="#">Climate-related financial disclosures 2021</a> (p. 27)</p>   |

### 3.2.3 Recommendation S.c: Describe the resilience of the organisation’s strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.

This TCFD recommendation suggests the use of a “2°C or lower scenario,” mainly from the consideration of a transition to a low-carbon economy. However, in the case of physical risks, it is important that a high temperature scenario is used to assess the potential risks from the physical impacts of climate change if emissions are not reduced and potentially if certain tipping points are reached, such as the melting of Arctic permafrost, which accelerates the release of greenhouse gases.

This recommended disclosure should discuss how resilient a financial institution’s strategy is to physical risks, using scenarios consistent with increased physical risks, such as the NGFS’s hothouse world or the IPCC Representative Concentration Pathway (RCP) 8.5, and should discuss the following:

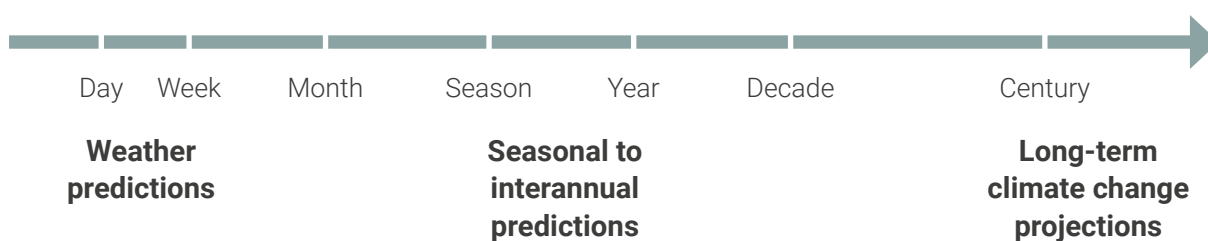
- What is the potential impact of physical risks on business, strategy, and financial planning? How does a financial institution plan to address them?
- What is the potential impact of physical risks on financial performance (e.g., revenues, costs) and financial position (e.g., assets, liabilities)?
- Which climate-related scenarios and associated time horizon(s) are used?

According to the TCFD’s “2021 Status Report,” disclosure of the resilience of companies’ strategies using scenario analysis is the least reported recommended disclosure—by only 13% of companies in 2020. As most companies and financial institutions are at an early stage in the fast-developing field of scenario analysis, the information provided for this recommended disclosure should encourage thinking on how to provide decision-useful information on key material risks using scenario analysis. Since scenario analysis provides forward-looking analysis, it often has implications for and is discussed with the recommended disclosures on risk management.

In our review of disclosures and other literature, we found that long-term time horizons of many financial institutions were around 10–30 years. Global warming and most other/related climate hazards will continue to intensify for at least two decades due to inertia in the geophysical system, even if global emission reductions are achieved immediately and are maintained (IPCC 2021). Consequently, different climate scenarios may yield very similar results in terms of changes in physical climate hazards over the coming two decades (UNEP FI 2019a). Thus, the following would hold:

- For the time period of 0–10 years, it can be more appropriate to conduct probabilistic/prediction analysis using historical climate data.
- For the time period of 10–30 years, a financial institution can use outputs from multi-model ensembles within a single climate scenario since differences between climate model assumptions and dynamics dominates uncertainties for this time period.
- For time horizons longer than 30 years, a financial institution can conduct scenario analysis using multiple climate scenarios.
- A financial institution should assess the distribution of impacts from multi-model ensembles for a given climate scenario, such as 95 percentile losses and 50 percentile losses, to capture modelling uncertainties.
- These time periods are not definitive. They should be adjusted based on the newest climate science, data, and modelling capabilities and uncertainties, as our understanding of climate change and modelling capabilities are fastly evolving. [Figure 12](#) illustrates the progression from prediction analysis to scenario analysis at different time horizons.

**Figure 12: A schematic illustrating the progression from an initial value-based prediction at short timescales to the climate projection at long timescales**



Source: IPCC 2013.

Physical risk scenarios can analyse both the direct and indirect impacts of possible climate consequences. The direct physical impact or risk scenario analysis requires a financial institution to have sufficient information on three building blocks of physical risk analysis: exposure, hazards, and vulnerability (IPCC 2021). Typically, physical risk scenarios provide hazards data and information by describing changes in physical hazards, such as extreme heat, hydrological drought, coastal floods, etc., for certain time periods. Those data can be outputs from climate models based on different climate scenarios or constructed from those outputs. Indirect impacts, such as macroeconomic conditions and sociopolitical stability, can be analysed, but can have significant uncertainties.

As part of conducting physical risk scenario analysis, a financial institution should carefully consider how to choose scenarios and climate models.

- **Scenarios:** Physical hazards or risks are becoming more frequent and intense, often in non-linear ways, as global temperatures rise. To assess physical risks and the magnitude of the challenge, an organisation should include a higher-emission scenario, such as Representative Concentration Pathway (RCP) 8.5, which has a central estimate of 4.4°C warming (IPCC 2021) or the Hothouse World scenario proposed by the NGFS.<sup>9</sup>
- **Climate models:** A financial institution should consider the geographical distribution of its assets, including financial assets, and their vulnerabilities in choosing the climate model(s) and multi-model ensembles. Climate hazard data are typically outputs from climate models running scenarios. Those climate models can range from global to regional and national models. Global models can provide consistency and comparability for assets across the globe but may not be as accurate or high resolution as regional or national models.

The following resources can help a financial institution get started on physical risk scenario analysis:

- **TCFD knowledge hub:** Scenario analysis. Link is available [here](#).
- **UNEP FI: Navigating a new climate:** Assessing credit risk and opportunity in a changing climate: Outputs of a working group of 16 banks piloting the TCFD recommendations. Part 2: Physical risks and opportunities. Link is available [y](#).
- **UNEP FI: Charting a new climate.** Link is available [here](#).
- **UNEP FI: Changing course:** A comprehensive investor guide to scenario-based methods for climate risk assessment, in response to the TCFD. Link is available [here](#).
- **UNEP FI: The Climate risk landscape:** Provides an overview of commercial climate risk tools and analytics providers that can support financial institutions in their risk assessment and scenario analysis. Link is available [here](#).
- **UNEP FI: The Climate risk tool landscape—2022 Supplement:** More in-depth assessment of climate risk tools and analytics including practical case studies. Link is available [here](#).
- **Climate financial risk forum:** Climate financial risk forum guide 2021: Scenario analysis. Link is available [here](#).
- **Institutional Investors Group on Climate Change:** Navigating climate scenario analysis: A Guide for institutional investors. Link is available [here](#).

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9 See the NGFS Scenario Portal, [ngfs.net/ngfs-scenarios-portal/](https://ngfs.net/ngfs-scenarios-portal/).



### Strategy 3. Scenario analysis

|                               |   |
|-------------------------------|---|
| <b>Base-level disclosures</b> | <p>Description of the potential impact of physical risks on business, strategy, and financial planning, including the use of a high-temperature scenario (4°C+), as well as a lower-temperature scenario to assess divergence across physical climate risk scenarios.</p> <p>Description of the scenarios used, including justification, key assumptions, data inputs, high-level outcomes, and their sources.</p> <p>Focus on vulnerable sectors highly exposed to a limited number of specific climate hazards.</p>   |
| <b>Next-level disclosures</b> | <p>Quantitative assessment, including stress testing, of the potential impact of physical risks on business, strategy, financial planning, and the resilience of a financial institution.</p>   |
| <b>Further considerations</b> | <p>Does choosing a high-temperature scenario matter for physical risk analysis? Many companies and financial institutions consider the long-term time horizon for business and strategy around 10–30 years. Within this time, physical climate impacts are largely locked in, and different GHG emission scenarios give rise to similar magnitudes and patterns of climate change. This may include the use of stress tests if they have been used to evaluate the resilience of an organisation’s business strategy under physical climate hazards, possibly in combination with other risks.</p> <p>What key assumptions of a scenario and data inputs should a financial institution disclose?</p> <p>Should there be a standardised scenario and standardised outputs of the scenario for physical risks?</p> <p>In assessing financial impacts, how is the damage function chosen and what are the key assumptions in this analysis?</p> |
| <b>Examples</b>               | <p>Figure B-11: Moody’s, <a href="#">TCFD report 2021</a> (p. 12)</p> <p>Figure B-12: Banco Santander, <a href="#">Climate finance report</a> (p. 13)</p> <p>Figure B-13: Lloyds Banking Group, <a href="#">Climate report 2021</a> (p. 70)</p> <p>Figure B-14: European Bank for Reconstruction and Development, <a href="#">TCFD report 2020</a> (p. 16)</p> <p>Figure B-15: Investec, <a href="#">Climate-related financial disclosures 2021</a> (p. 37)</p> <p>Figure B-16: AIB, <a href="#">Climate &amp; environment report 2021</a> (p. 31)</p> <p>Figure B-17: Macquarie, <a href="#">Macquarie and climate change: TCFD implementation progress and scenario analysis</a> (p. 15)</p> <p>Figure B-18: Macquarie, <a href="#">Macquarie and climate change: TCFD implementation progress and scenario analysis</a> (p. 16)</p> <p>Figure B-19: ING, <a href="#">Climate risk report 2020</a> (p. 21)</p>                              |

### 3.3 Risk management

The risk management disclosures provide information to investors and other stakeholders on how a financial institution's physical risks are identified, assessed, and managed. The TCFD recommendations also encourage integrating those disclosures into existing risk management processes and disclosing those processes. So far, the risk management disclosures published for physical risks generally focus on individual hazards or industries, which can be a different approach from disclosures using fully integrated, enterprise-wide risk management processes.

Companies' disclosures of their risk management processes and whether those processes are integrated into the company's overall risk management are generally poorly disclosed in comparison to other recommended disclosures, according to the TCFD's "2021 Status Report." Among companies surveyed by the TCFD, 75% said the Risk Management recommendations are difficult to implement (TCFD 2020). We found low responsiveness to these recommendations in our own review of physical risk disclosures. In addition, most financial institutions that did disclose, provided qualitative and general information.

We did not include a stand-alone section for the last Risk Management–recommended disclosure, "Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management." Most disclosures reviewed did not have a separate discussion on this recommended disclosure, instead, they integrated it into the first two recommended disclosures of identifying, assessing, and managing physical risks or in the location of their disclosures. For example, a number of banks included a climate risk disclosure in their annual report, alongside other material risks, while another example of disclosure highlights the identification of climate risk as a principal risk that needs to be considered at the same level as other material risks. One example is given in Appendix B: Figure B-4: Barclays PLC, [Climate-related financial disclosures 2021](#) (p. 27).

### 3.3.1 Recommendation RM.a: Describe the organisation’s processes for identifying and assessing climate-related risks

Under this recommended disclosure, financial institutions should discuss the process for identifying and assessing physical risks, including how a financial institution determines the relative significance of physical risks with respect to other risks. In addition, a financial institution should disclose definitions of risk terminology used or references to existing risk classification frameworks.

Financial institutions are encouraged to consider TCFD’s supplemental guidance for this recommended disclosure, for example, to characterise physical risks in the context of banking risk categories, such as credit risk and liquidity risk.

| Risk Management 1. Risk ID & assessment |  |
|---|--|
| <b>Base-level disclosures</b>           | <p>Description of risk terminology used.</p> <p>Reference to existing risk classification frameworks and explanation of why they are selected.</p> <p>Description of how physical risks are identified and their relative significance with respect to other risks.</p> <p>Description of tools, methodologies, technology, and external vendors used.</p> |
| <b>Next-level disclosures</b>           | Description of physical risks in the context of existing risk categories used by a financial institution   |
| <b>Further considerations</b>           | How to standardise the process of identifying and assessing physical risks, including the data used?   |
| <b>Examples</b>                         | <p>Figure B-20: Bank of America, <a href="#">Responsible growth and a low-carbon economy</a> (p. 15)</p> <p>Figure B-21: Lloyds Banking Group, <a href="#">Climate report 2021</a> (p. 54)</p> <p>Integrating exposure &amp; vulnerability (BNP Paribas)</p>   |

### 3.3.2 Recommendation RM.b: Describe the organisation’s processes for managing climate-related risks

This recommended disclosure discusses the processes of a financial institution for managing and prioritising physical risks, including how it makes decisions to mitigate, transfer, accept, or control those risks. In addition, a financial institution is requested to disclose how materiality of physical risks is determined. We found this recommended disclosure was often discussed together with the second and third recommended Strategy disclosures, describing the impact of climate-related risks and scenario analysis. It would aid transparency and comparability if this recommended disclosure were explicitly addressed in reports.

| Risk Management 2. Risk management process |   |
|--|---|
| <b>Base-level disclosures</b>              | Describe decisions to mitigate, transfer, accept, or control physical risks identified.   |
| <b>Next-level disclosures</b>              | Describe climate-adaptation strategies and practices a financial institution used to increase its resilience to physical risks, including around client engagement.   |
| <b>Further considerations</b>              | <p>What is the role of insurance companies in managing physical risks, particularly in non-insurance financial institutions? How are physical risks translated into credit risks given the role of insurance?</p> <p>How does a financial institution integrate climate risks into client engagement, both in terms of identifying and managing physical climate risks? Are clients developing adaptation or disaster risk management plans?</p> <p>Does risk management provide opportunities for financing products or processes that increase a client’s climate resilience?</p> |
| <b>Examples</b>                            | <p>Figure B-22: Lloyds Banking Group, <a href="#">Climate report 2021</a> (p. 55)</p> <p>Figure B-23 and Figure B-24: Standard Chartered, <a href="#">Facilitating climate action where it matters most</a> (p. 49)</p> <p>Figure B-25: Standard Chartered, <a href="#">Facilitating climate action where it matters most</a> (p. 47)</p>   |

## 3.4 Metrics and targets

Metrics and targets are at the core of a climate-related risk disclosure as they provide the institution, investors, and others with the information necessary to understand the risks faced by that institution and, over time, how successfully the institution is addressing those risks. While target-setting has become increasingly important for financial institutions committed to realigning their business with a net-zero emissions pathway, there is currently no such pathway for target-setting against mitigating physical climate risks or alignment with adaptation goals. However, financial institutions may set their own physical risk-related targets, for example, by tracking “exposure to climate-sensitive sectors (physical risks)” and aiming to reduce this exposure over time. Our review of disclosures revealed a handful of disclosures that also highlight actions financial institutions are taking to support climate adaptation.

The TCFD lists three recommended disclosures under Metrics and Targets, of which the second is focused on the disclosure of greenhouse gas emissions. This guidance on physical risk disclosures focuses, therefore, on the first and third disclosures.

Given the range of physical hazards identified in the IPCC AR6 and the methodologies available to assess physical climate risk, the range of metrics and targets is vast and designed to meet different objectives. The choice and deployment of metrics for financial disclosures continues to expand as risk assessments become increasingly widespread and data become more readily available. This section sets out how metrics and targets are identified, the kinds of metrics and targets available (in Box 4), and how they may be used in TCFD-aligned disclosures.

### Box 4: Physical risk metrics

#### What are metrics for?

Metrics are seen as being the “connective tissue” between the other recommendations: Governance, Strategy, and Risk Management. Quantitative metrics allow for potentially more accurate and informative measurement of risks than qualitative information, as well as allowing risks to be compared across time both within and beyond the organisation and in comparison with other organisations. However, quantitative metrics are only as good as the data inputs and methodologies used to calculate the metrics and can therefore usually only provide an estimate of risks and in some cases can provide a misleading view of potential risks. To address these issues, it is important that disclosures are transparent with regards to input data and methodologies, and that data inputs and methodologies are updated over time in order to respond to data access and technological developments, with a view to improving the quality of disclosures. Physical risk metrics are built from three key components (see Figure B1.1):

- Hazard (physical climate data)
- Exposure (asset-level data)
- Vulnerability (damage function)

Given the range of hazards and the very different exposures and vulnerabilities of specific assets, physical risk metrics are numerous. Physical risk metrics are highly dependent on the hazards associated with a particular industry sector, location, and type of asset, and are therefore a challenge to calculate. Comparability and standardisation of approaches is unlikely in the near-term, and consistency is likely to be hard to tackle given these challenges. Experimentation and innovation will remain important in the near term, based on guiding principles such as the four key characteristics set out by the TCFD Secretariat for metrics:

- Decision-useful (for investors and markets)
- Clear and understandable
- Reliable, verifiable, and objective
- Consistent over time

### 3.4.1 Relevant metrics for climate-related physical risk disclosures

#### Types of metrics

In the context of climate-related physical risk disclosures, we can identify two key types of risk metrics:

1. **Physical climate risk metrics**—these measure the direct risk from the physical impact of climate change in terms of non-financial indicators and can incorporate the following:
  - **Hazard-specific indicators.** These assess the probability of a specific hazard affecting an asset. These may be estimated using granular models, such as computational hydrological models in the case of river flooding, or estimated across regions, depending on the granularity of source data. These are often used where hazard and asset data are readily available, for example, mapping flood risk from a 1-in-100-year return period flood<sup>10</sup> for a specific physical asset.
  - **Aggregate physical risk indicators incorporating the vulnerability of specific assets and their exposure to those hazards.** An aggregate physical risk metric for a business line or sector can be estimated by applying a hazard-specific risk indicator across portfolio-linked assets. These metrics would incorporate the vulnerability of a particular asset.<sup>11</sup> These metrics also incorporate a financial institution's exposure, for example, proportion of the asset's value that is linked to the financial institution. Such metrics as "number of assets exposed to high

10 A 100-year flood is a [flood](#) event that has a 1 in 100 chance (1% probability) of being equalled or exceeded in any one year, and it has an average recurrence interval of 100 years (USGS 2022).

11 The vulnerability can be reduced by asset-level measures and landscape measures. Asset-level measures: actions that can be taken by the asset owner, e.g., to take the flooding example, whether an asset has been "flood-adapted" by raising electrical points, installing flood protection barriers on windows and doors, and so on. Landscape measures: actions that are generally taken by governments at the municipal, regional, or national level, e.g., whether a physical asset is protected by large-scale flood defences, flood retention ponds, stormwater drainage, etc.

flood risk” or “% of mortgage portfolio exposed to high flood risk” incorporate hazard impacts, vulnerability, and exposure but do not attempt to estimate financial risk.

- **Aggregate risk indicators identify concentrations of multiple risks from both acute and chronic drivers.** These metrics are often less granular than hazard-specific risk indicators and may be used to provide a high-level indication of risks, for example, for risk concentration heatmaps, or for financial products where asset-level data are not readily available, such as for sovereign bonds. Given these are aggregate metrics, they are often in the form of semi-quantitative or qualitative asset-level risk scores. An example would be the ND-GAIN sovereign risk indicator.<sup>12</sup>

- 2. Climate-adjusted financial risk metrics**—these measure the risks from the physical impacts of climate change in terms of standard financial risk metrics commonly used by banks and investors. These metrics will incorporate vulnerability and exposure, as well as a damage function that translates these risks in financial risk terms. It should be noted that damage functions will vary according to asset type and characteristics, hazard type and severity, time horizon, and location. The availability and reliability of damage functions rely heavily on data availability and institutional capacity to conduct such analysis. Even then, damage functions are subject to considerable uncertainty (BCBS 2021b).

The TCFD’s “Guidance on metrics, targets, and transition plans” identifies a portfolio-level metric to measure an organisation’s vulnerability to physical climate risks: “Amount and extent of assets or business activities vulnerable to physical risks,” measured as a percentage of the portfolio or an absolute amount in terms of numbers of assets or financial value (TCFD 2021c). This type of metric incorporates the hazard, the vulnerability of assets, as well as a financial institution’s exposure, and is probably the best way to measure potential climate risks without introducing the complexities of a damage function, which can be highly location- and sector-dependent (see “Challenges of physical risk metrics” below). For a bank just starting to assess physical risks, it could allow for a physical risk metric focused on one sector from one hazard, for example, percentage of mortgage portfolio in the United Kingdom vulnerable to 1-in-50-year flooding in 2040. For banks with more advanced disclosures, it could allow for a financial metric across a portfolio from multiple climate hazards, for example, amount (in USD) of lending portfolio at risk from physical climate impacts in the 27 European Union countries (EU27) in 2040.

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12 [gain.nd.edu/our-work/country-index/](https://gain.nd.edu/our-work/country-index/).

## Challenges of physical risk metrics

Selecting and measuring physical risks present several challenges. This often results in financial institutions identifying and assessing physical climate-related risks in terms of aggregated semi-quantitative or qualitative climate risk scores, rather than more granular quantitative measurements:

- **Data availability.** This can be a considerable issue, including short data records, data gaps and holes, erroneous measurements, lack of data, and type of measurement instrument.
- **Methodological complexity.** For example, where data or financial resources are limited, the use of stochastic modelling techniques to calculate flood risk probabilities will result in widening error levels with decreasing exceedance probability. Small variations in the model parameters can result in considerable changes in the exceedance probability.
- **Misalignment in applied data.** Differences in data records and methodologies can result in considerable differences between data sets. For example, one bank identified considerable differences between flood maps in different countries with respect to resolution, coverage, return period, scenario analysis, and types of flooding.
- **Hazard-specific metrics.** Metrics specific to individual climate hazards, such as flood return periods or heat stress indices, may not be comparable both between hazards and geospatially, for example, heat stress in northern Europe may have a different range than heat stress in the Arabian Gulf.
- **Damage functions.** These are used to translate physical impact metrics into financial metrics. Unfortunately, the availability of damage functions is limited for a number of reasons (Prahl et al. 2016):
  - Lack of observations of financial costs due to climate-related events
  - High uncertainty in the robustness of damage functions due to weak correlations between financial losses and the damage event
  - Difficulty in isolating multiple variables that might influence the financial impact of a climate-related event

## Physical climate risk metrics

As a starting point, physical climate risk disclosures should focus on identifying metrics that allow the exposure of the portfolio or part of a portfolio to existing physical climate risks in non-financial terms. These metrics can either be in the form of generic risk scores or metrics that are relevant to the hazard identified. Ideally a disclosure should provide an aggregate risk score, such as the “Proportion of portfolio highly exposed to key indicators of physical risks, by geography/sector,” as recommended by the TCFD (2021c), with sufficient information on the methodology and specific physical hazard metrics, for example, flood return periods or drought indices, underlying this aggregate measure. Given the wide range of physical hazards and metrics for quantifying risk exposure, [Table 5](#)



provides just a small handful of the examples we have found in disclosure reports by banks and investors. The NGFS Directory provides a comprehensive database of possible metrics for all climate-related risks, both transition and physical.<sup>13</sup>

**Table 5: Examples of physical climate risk metrics**

| Metric   | Hazard type              | Units       | Description   |
|--|--------------------------|-------------|---|
| <b>Hazard-specific</b>   |                          |             |   |
| No. of properties in climate-adjusted 1-in-100-year flood zone       | Inland/ Coastal flooding | No.         | Based on a measurement of future climate-adjusted 1-in-100-year flood zones, usually assumed to be without flood protection measures.<br>e.g., “Properties in red flood risk zone” ( <a href="#">Nationwide BS</a> ).   |
| No. of properties in climate-adjusted zone 4 tropical cyclone region | Extreme weather          | No.         | Based on a measurement of estimated tropical cyclone speeds, where zone 4 is 252–299 km/h.<br>e.g., hazard ratings used to assess physical risks to own operations using MunichRe NATHAN model ( <a href="#">Standard Chartered</a> , p. 52).   |
| Average annual rainfall  | Water stress             | mm          | Using average annual rainfall in mm to assess variability in annual rainfall to identify water stress hotspots.<br>e.g., water stress assessment ( <a href="#">ANZ</a> , p. 8).   |
| No. of properties in high fire risk zones                            | Wildfire                 | No.         | Estimated number of properties at risk from wildfire according to a nationally or internationally recognised wildfire metric.<br>e.g., assessing wildfire risk according to the Fire Weather Index (FWI) of the US National Wildfire Coordinating Group (NWCG) ( <a href="#">Macquarie</a> , pp. 17–18).                  |
| <b>Aggregate</b>   |                          |             |   |
| Average annual disruption  | Risk (Static)            | People-days | This metric assesses the disruption to operations in terms of lost working “people-days” from one or multiple climate risks.<br>e.g., forward-looking change in disruption under RCP 8.5 for North America, Japan, Europe under multiple hazards, including storm, flooding, wildfire ( <a href="#">Moody's</a> , p. 16). |

13 See [ngfs.dev.masdkp.io/](https://ngfs.dev.masdkp.io/).

| Metric  | Hazard type   | Units    | Description   |
|---|---------------|----------|---|
| Proportion of portfolio highly exposed to key indicators of physical risks, by geography/sector   | Risk (Static) | %        | <p>This metric assesses the exposure of assets/organisations to physical risks by indicating the <i>concentration of risk</i> in the existing portfolio. Initial progress has been made by banks in certain sectors in certain geographies based on data availability.</p> <p>Defined in the TCFD’s “Guidance on metrics, targets, and transition plans” as “Amount and extent of assets or business activities vulnerable to physical risks.”</p> <p>Corresponds also to EU reporting guide KPI, “% assets committed in regions likely to become more exposed to acute or chronic physical risks” (EC 2019).</p> <p>e.g., % regional mortgage lending exposed to “high” or “very high” flood risk, according to national risk levels (<a href="#">NatWest</a>, p. 63).</p> |
| Credit risk exposure of portfolio in relation to key indicators of physical risk, according to the bank’s prioritisation of risk, by geography/sector | Risk (Static) | \$m risk | <p>Indication or concentration of risk in existing portfolio based on potential losses rather than portfolio value.</p> <p>e.g., estimated current exposure to flood risk losses in £bn (<a href="#">Nationwide BS</a>, p. 52).</p>   |

Notes: Km/h = kilometres/hour; mm = Millimetres; KPI = Key Performance Indicator; \$m = Dollars, millions; £bn = Pounds, billions.

**Source: Authors**

## Climate-adjusted financial risk metrics

Once a financial institution has an understanding of the kind of physical hazards to which it is exposed and to the magnitude of those risks in climate terms, the next step may be to estimate the financial risk, using damage functions. The limitations of these functions are described above and, as a result, very few disclosures (only three bank disclosures) reviewed by the authors contained financial risk metrics specifically relating to the impact of physical climate hazards.

Despite these challenges, climate-related financial risk metrics demonstrate certain advantages:

- Integration into a financial institution’s risk management framework
- Comparability between different risk types
- Measure not only exposure of assets to a climate-related physical hazard but also the vulnerability of that asset and the bank’s financial exposure to those losses

Ideally, financial risk metrics should be used where uncertainties in quantifying financial losses can be minimised. Financial risk metrics should correspond to the risk metrics already in use by the financial institution and connect to the risk appetite statement, so that they can be integrated into the overall risk management framework. Correlation can be used to provide an indication of financial risks where damage functions are unavailable or unreliable. Examples of financial risk metrics that integrate physical climate risk metrics in disclosures reviewed by the authors are listed in [Table 6](#):

**Table 6: Examples of climate-adjusted financial risk metrics**

| Metric   | Type         | Units                             | Description   |
|--|--------------|-----------------------------------|---|
| <b>Advanced disclosure</b>   |              |                                   |   |
| Total expected losses under climate scenarios                          | Risk (P & T) | \$m losses                        | Can be based on Loss-Given Default (LGD) or Exposure at Default (EAD). Estimation of these figures can be very challenging and will depend on a client's exposure, vulnerability of assets, insurance, etc.   |
| Climate-adjusted Loan-to-Value ratios                                  | Risk (P)     | % (ratio)                         | Loan-to-Value ratios for real estate, adjusted to take into account the impact of future climate risks over the remaining term of the mortgage.   |
| Climate Value-at-Risk (VaR)  | Risk (P & T) | \$m VaR                           | Forward-looking and return-based valuation assessment to measure climate-related risks and opportunities in an investment portfolio (MSCI 2021).  |
| Correlation between physical climate hazards and financial information | Risk (P)     | Correlation coefficient (r value) | Correlation assessment between physical climate risks and financial data, such as asset values. e.g., correlation between fire zones (wildfires) and property asset values and revenue (Standard Bank case study in <a href="#">UNEP FI 2020</a> ). |

Notes: P = Physical risk; T = Transition risk.

**Source: Authors**

In this guide, as can be seen from the tables in section 4.4.2 and the suggested disclosures in section 4.4.3, we have suggested that base-level disclosures should include a qualitative assessment that can be employed across a portfolio to identify risk concentration “hot spots,” possibly with hazard-specific metrics where specific physical hazards pose a particular risk to assets. Climate-adjusted financial risk metrics necessitate scenario analysis and translation into financial metrics and therefore should be considered as “next-level disclosures.”

### Metrics to measure financing of climate resilience

Certain jurisdictions are now requesting financial institutions to identify, assess, and measure their financial allocations to climate- or environmental-related activities. For instance, the European Union’s Non-Financial Reporting Directive (NFRD) requires all firms, including financial institutions, to disclose a Key Performance Indicator (KPI) relating to the percentage of turnover or CapEx/OpEx substantially contributing to the six EU Taxonomy-aligned activities, including climate adaptation (European Parliament and European Council 2014). Multilateral development banks (MDBs) have also developed approaches for identifying and measuring financial flows towards climate adaptation or

resilience-building activities. Individual financial institutions may also want to publicise their support for climate resilience in clients and back this up with relevant metrics.

Defining climate adaptation activities and measuring their impact, even with a standard taxonomy, can be very challenging, given that climate resilience is usually not a stand-alone action, and it is difficult to disaggregate and quantify. [Table 7](#) provides some examples of climate-resilience metrics. For further information on adaptation metrics, refer to the UNEP DTU Partnership’s paper for the Global Commission on Adaptation (2019).

**Table 7: Examples of climate resilience metrics**

| Metric   | Units                     | Description   |
|--|---------------------------|---|
| Capital deployment—Amount of portfolio deployed towards climate-related risk and opportunities | \$m                       | This is a blanket metric to cover all expenditure on climate adaptation-related measures (e.g., soil health, irrigation, technology, flood resilience). See TCFD 2021c.<br>Corresponds also to the EU reporting guide Key Performance Indicator (KPI): “% turnover or % CapEx/OpEx substantially contributing to climate adaptation.” |
| Climate-risk reduction   | Δrisk                     | For projects. Could be used to assess the change in financial risk metric due to financing a climate adaptation component. One approach used by the Climate Bonds Initiative’s Climate Resilience Principles (CBI 2019).  |
| Resilience rating system   | Semi-quantitative measure | Used by the World Bank to assess the climate resilience of (or through) investment and projects, grades A+ to D and measures extent to which climate and disaster risks will materially affect the asset (World Bank 2021).   |

Notes: \$m = Dollars, millions.

**Source: Authors**

### **3.4.2 Recommendation M.a: Disclose the metrics used by the organisation to assess climate-related risks and opportunities in line with its strategy and risk management process**

Institutions should respond to three key questions with respect to this recommendation (TCFD, 2021b):

- Which performance metrics does the company use to assess and manage financially material climate-related physical risks and opportunities such as those related to water, energy, land use, and waste management?
- Are the methodologies used to calculate or estimate climate-related physical impact metrics clear?
- Do the disclosed metrics and targets disclosed provide historical trends and forward-looking projections (by relevant country and/or jurisdiction, business line, or asset type)?

Metrics should cover not only the potential risks but also the opportunities from the physical impacts of climate change. However, unlike transition-related opportunities focusing on low-emissions or emissions-reduction technologies, identifying such opportunities is currently not well defined. Some metrics for measuring improved resilience and investments in climate-adapted activities have been developed, largely by MDBs. The EU Taxonomy for sustainable activities also defines how adaptation activities should be measured (EC 2021), though UNEP FI and European Banking Federation (EBF) research on the Taxonomy is almost entirely focused on mitigation as a primary activity, showing perhaps that identifying and measuring finance for adaptation remains very difficult.

## Metrics & targets 1. Metrics

|                               |  |
|-------------------------------|--|
| <b>Base-level disclosures</b> | <ul style="list-style-type: none"> <li>■ Heatmaps to identify risk concentration “hot spots” in hazards, sectors, and geographies of relevance to the institutions’ core business market.</li> <li>■ Types of metrics:             <ul style="list-style-type: none"> <li>□ Aggregated metrics that provide semi-quantitative or qualitative physical climate risk scores to identify the most exposed sectors and geographies to physical hazards over the short, medium and long terms.</li> <li>□ Hazard-specific metrics that provide more granular identification of sector vulnerabilities in identified risk “hot spots.”</li> <li>□ In own operations: waste, water, and materials consumption, as well as levels of reuse and recycling.</li> </ul> </li> <li>■ Outline methodologies, including data sources, scope of application, critical parameters, assumptions, and limitations.</li> </ul>  |
| <b>Next-level disclosures</b> | <ul style="list-style-type: none"> <li>■ Types of metrics:             <ul style="list-style-type: none"> <li>□ Key metrics that indicate or estimate forward-looking climate-related financial risks to the portfolio from physical climate risks.</li> <li>□ Adaptation and resilience metrics that estimate financial flows going towards physical risk opportunities.</li> </ul> </li> <li>■ More detail on methodologies used to calculate both risk and opportunities, including data sources, scope of application, critical parameters, assumptions, and limitations.</li> <li>■ Methodologies behind financial loss estimation using damage functions or similar.</li> <li>■ Linking metric-based analysis back to company strategy.</li> <li>■ Estimation of supply-chain exposure to physical climate risks.</li> <li>■ Over time, demonstrating progress on key metrics, estimating how these will develop in the future, and how strategy has impacted on these metrics over time.</li> </ul> |
| <b>Further considerations</b> | <ul style="list-style-type: none"> <li>■ How often to update and disclose data?</li> <li>■ How to integrate metrics from disparate physical risk frameworks?</li> <li>■ When using financial risk metrics, which damage functions to use and how to reconcile with financial accounting standards? Should there be a physical risk equivalent of the GHG Protocol and accounting standards for greenhouse gas emissions such as the Partnership for Carbon Accounting Financials (PCAF)?</li> <li>■ What should be considered as standard metrics?</li> <li>■ How to tackle compound risks?</li> </ul>   |
| <b>Examples</b>               | <p>Figure B-29: Nationwide Building Society, <a href="#">Annual report &amp; accounts 2021</a></p> <p>Figure B-27: Natwest Group PLC, <a href="#">2021 Climate-related disclosures report</a></p> <p>Figure B-28: The Goldman Sachs Group, <a href="#">Accelerating transition: Task force on climate-related financial disclosures report 2021</a></p> <p>Figure B-30: UBS, <a href="#">Climate report 2021</a></p>   |

### 3.4.3 Recommendation M.c: Describe the targets used by the organisation to manage climate-related risks and opportunities and performance against targets

Setting targets to reduce physical risks and scale financial flows for adaptation would reduce a financial institution's exposure to physical climate risks over time, while opening up new opportunities for investment in a changing climate. The TCFD's "Guidance on metrics, targets, and transition plans" (2021) outlines a number of key characteristics to ensure targets are "specific and complete," which apply equally to physical risks as to emissions reduction targets. Targets should be:

- aligned with Strategy and Risk Management goals
- linked to relevant metrics
- quantified and measurable
- clearly specified over time

The TCFD's original recommendations also asks the following:

- Has the company established and communicated climate-related performance targets in line with anticipated regulatory requirements, market constraints, or other goals, such as operational or financial objectives or loss tolerances?

Currently very few published disclosure reports from financial institutions provide any information on target-setting for physical risks, especially as there are no internationally agreed targets or goals on climate resilience. However, even high-level physical risk assessments should be able to identify targets for addressing identified risk concentrations in given sectors or geographies, or setting targets to reduce climate risk by financing climate resilience. Such targets would build on the metrics used in the disclosure report to measure physical climate risks. For example, a financial institution could aim to reduce the number of properties in climate-adjusted flood zones, or in high fire risk flood zones, with an additional target of no new financing in such high risk zones. Targets could also be financial if the financial institution has used financial risk metrics, e.g. reduction in total expected losses under climate scenarios. Derisking finance in climate vulnerable sectors and regions should be accompanied by dialogue with national and local government, insurers and clients in order to explore different options to adapt to climate change, setting financing restrictions as a last resort. Soft targets could also be set around product development, client engagement and policy advocacy in key sectors and regions exposed to physical climate hazards. Further work on adaptation and resilience for banks will be explored by UNEP FI in the coming years.

### Metrics & targets 3. Targets

|                               |  |
|-------------------------------|--|
| <b>Base-level disclosures</b> | <ul style="list-style-type: none"> <li>▪ Targets for reducing exposure to climate-related risks in identified risk concentration “hot spots.” These are likely to be based on semi-quantitative or qualitative metrics. This will only be possible if metrics meet the TCFD’s key characteristics for at least one hazard and one sector.</li> <li>▪ Demonstrate progress by showing changes in metrics over time. Metrics from year-to-year should be comparable and transparent, with any changes to metrics or targets disclosed and explained.</li> <li>▪ Demonstrate plans for operationalising targets.</li> <li>▪ In own operations, set targets for reducing waste, water consumption, and other material resources. Set targets for reusing and recycling waste.</li> </ul> |
| <b>Next-level disclosures</b> | <ul style="list-style-type: none"> <li>▪ As financial institutions expand their assessment of physical risks across sectors and geographies, introduce portfolio, sector, or geographical targets for reducing exposure to multiple climate-related physical risks.</li> <li>▪ Targets for reducing exposure in terms of financial losses from physical impacts of climate change.</li> </ul>  |
| <b>Further considerations</b> | <ul style="list-style-type: none"> <li>▪ With limited data and metrics for setting targets, what can the institution do to demonstrate action on building climate resilience with clients and in own operations?</li> <li>▪ Even if damage functions become more available and reliable, are targets related to financial risk metrics more decision-useful than physical climate risk metrics?</li> <li>▪ Targets to reduce exposure to physical climate risks could lead to divestment and capital outflow from vulnerable regions and communities. How can financial institutions demonstrate a positive contribution to climate resilience?</li> </ul>   |
| <b>Examples</b>               | <p>No current examples of good practice</p>  |



### 3.5 Positioning of physical risk disclosures for external reporting

Financial institutions reviewed by the authors have shown different approaches to the positioning of reporting on climate-related physical risks, and this can be seen in the table below showing the location of disclosures by banks:

| Location of disclosures in standard reports |                         |               |                |     |                  |         |      |
|---|-------------------------|---------------|----------------|-----|------------------|---------|------|
| Type of report                              | Annual financial report | Non-financial | Sustainability | ESG | CDP <sup>a</sup> | Climate | TCFD |
| Number                                      | 5                       | 4             | 6              | 3   | 2                | 7       | 30   |
| Percentage (out of 57 total reports)        | 9                       | 7             | 10             | 5   | 4                | 12      | 53   |

Notes:  
 a. Standard reporting in line with the CDP reporting requirements, see [CDP reporting guidance](#) (2020). Counting of CDP reports in this case is only where physical risk disclosures are not available elsewhere. ESG = Environmental, social, and governance.

What this shows is that financial institutions are making independent decisions on how they report climate-related risks, and there is no hard and fast rule standard for where to disclose climate risks. However, the TCFD recommends that organisations provide climate-related disclosures in their annual financial filings. Should this not be in line with their legal obligations, then supporting information should be provided in separate reports that adhere to the same robust internal governance and risk management processes as for financial reports.

The location of a climate-related risk disclosure may be dependent on the following:

- Regulatory or supervisory requirements—Of primary importance are the regulatory or supervisory requirements that organisations are required to follow. In the European Union, for example, Article 449a of the Capital Requirements Regulation (CRR) requires climate-related disclosures in line with Pillar 3 reporting requirements. The United States’ Securities and Exchange Commission’s recently published draft climate disclosure rule provides very specific reporting requirements, including in Exchange Act annual reports (SEC 2022).
- Materiality of identified climate-related risks—Climate risks have been deemed to be material by a number of supervisors and regulators. Where identified, they should be disclosed, as other material risks, in annual reports.
- Resources available—Specific climate risk disclosure reports are often used where there have been significant resources allocated to develop scenario analysis, possibly across multiple sectors and geographies and across transition and physical climate risks. A more cost-effective approach can be to report through sustainability or non-financial reports, which may include a section on climate-related risk.

- Targeted audience—A financial institution may want to provide examples of in-depth aspects of its climate-related risk assessment, such as heatmapping, individual physical hazard assessments, and detailed scenario analyses—to provide comprehensive and transparent information on models, methodologies, data sources, assumptions, etc., for clients, investors, regulators, and other consumers of disclosures. Institutions may also want to provide information on their climate-related activities that go beyond regulatory requirements or the recommendations of the TCFD or ISSB, in terms of supporting climate adaptation and building resilience with clients and in communities in which they operate.

## 4. Conclusion and areas for further work

Through our review of disclosures and engagement with stakeholders, it is clear that physical climate risk disclosures are still in their infancy, despite some progress since the launch of the recommendations of the TCFD. This report found that no financial institution has disclosed all TCFD-recommended disclosures for physical risks, and those published vary widely in quality and coverage. Consumers of disclosures may find some disclosures helpful in understanding the physical risks presented by climate change for a specific financial institution, but it is nearly impossible to compare disclosures by different financial institutions even if they are in the same industry within the financial sector. Our findings point to several areas that can increase the capacity of organisations to identify, assess, and disclose physical risks.

**Providing more technical details and standards to existing physical risk frameworks can increase the capacity of organisations to identify, assess, and disclose physical risks.** Every financial institution may face different types of physical risks shaped by its sector-specific characteristics, location of assets, and climate-resilience capacities. The TCFD recommendations provide a high-level standardised disclosure framework, but standardised definitions, guiding principles, and methods to quantify hazards, exposure, and vulnerability, based on the latest climate science, would provide a common foundation for physical risk assessment. This would help address the complexity and technicality of physical risks and make disclosures more complete and consistent. We do not aim in this guide to define how such a framework should be developed or by whom, but it would need to be global in scope, with regional granularity, and be developed collaboratively across institutions that could adopt and integrate standards into existing frameworks (see also NGFS 2022).

**Expanding access to physical risk data, integrating climate risk assessments with client data, as well as further innovations in data management and assessment methodologies can improve the quality and decision-usefulness of physical risk disclosures.** Participants in the workshop and survey often cited that data and methodology issues related to availability, comparability, and transparency were major barriers to assessing and disclosing physical risks.

- **Improvements could be made across both internally- and externally-sourced data.** Internally, financial institutions should enhance data-aggregating across risks, and client and finance systems, such as customer asset location and specification data.

- **Externally, there are many options and providers for physical hazard data and scenarios with varying quality, approaches, and models, which create challenges for comparing physical risk disclosures.** Open-source developers should be supported to provide data for key physical hazards that will scale the implementation of physical risk assessments, particularly by smaller organisations.
- **It is difficult to accurately and consistently estimate the financial impact of physical risks due to uncertainties and assumptions included in methodologies and tools.** Such estimates need to use methods for quantifying probabilities and impacts for a given asset location across various timescales and scenarios, while considering the asset's unique vulnerability to different types of climate hazards. Harmonisation of methodological standards, as described above, should facilitate this.
- It is unlikely that those data and methodology issues can be solved in the immediate future. As a result, **transparency about data and methodology is essential** so that consumers of physical risk disclosures can understand the source of data, the underlying assumptions, and methodologies. Those are prerequisites to understand and interpret physical risk disclosures.
- **An assessment of a single climate hazard on a limited selection of a portfolio can only provide a partial picture of the potential physical risks.** Developing the methodologies to assess the impacts of multiple concurrent climate-related hazards, transition-related risks, and wider socioeconomic risks that could arise independently or as a consequence of climate change, would allow financial institutions a more realistic picture of potential forward-looking risks.

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# Appendix A. Climate-related financial disclosure regulation and physical risks

Regulations and supervisory guidance developed over the past years generally adopt the framework of the TCFD's recommendations, and while this approach assumes that climate-related risks are related to both: (1) the transition to a low-carbon economy, and (2) the physical impacts of climate change, the emphasis on delivery tends to be on transition risks. This is understandable given the near-term priority to reduce greenhouse gas emissions as rapidly and as smoothly as possible. This emphasis can be seen in the recommendations of the TCFD (use of 2°C or lower scenarios and disclosure of Scopes 1, 2, and 3 emissions) and in the progress reports of the European Central Bank (ECB 2020b; ECB 2022) and the United States' Security and Exchange Commission's draft climate disclosure rule (SEC 2022).

This appendix highlights some key climate-related disclosure regulations in the European Union and the United Kingdom, as well as proposals in the United States of America, and identifies if and how special provisions are made for physical risks.

## European Union

Pillar 3 prudential disclosures are applicable to large listed banks<sup>14</sup> under the Capital Requirements Regulation (CRR) and large ("Class I") investment firms reclassified as credit institutions under the Investment Firms Regulation (IFR) and therefore also regulated by the CRR. In line with Article 449a, the Implementing Technical Standards (ITS) specifies reporting requirements, built around the following:

- Recommendations of the TCFD
- The European Commission's "Guide to reporting climate-related information" (EC 2019)
- The EU Taxonomy, the Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020, on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088

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14 The Capital Requirements Regulation [[Regulation \(EU\) 575/2013](#)] defines "large financial sector entities" as those that have "total assets greater than or equal to a EUR 70 billion threshold, using the most recent audited financial statement or consolidated financial statement in order to determine asset size."

The materiality of transition risks is reflected in the five reporting templates for climate-related disclosures, but only one on covering physical risks, which requires information on exposure to acute or chronic physical risks across nine key sectors. Given the European Union's recognition of the importance of reporting in terms of "double materiality," that is, the impact of the firm on the climate as well as the impact of climate risks on the firm, there are also templates covering the Green Asset Ratio (GAR) and the Banking Book Taxonomy Alignment Ratio (BTAR), allowing financial institutions to report on the alignment of their financing of Non-Financial Reporting Directive (NFRD)-regulated companies (GAR) or overall loan book (BTAR) with the EU Taxonomy, including those activities contributing substantially to climate adaptation.

In addition to Pillar 3 disclosures, the "Guide to reporting climate-related information" (EC 2019) provides important guidance on identifying, assessing, and reporting climate-related (transition and) physical risks under the Non-Financial Reporting Directive (NFRD). It includes two key physical risk and adaptation-related metrics:

- Percentage of assets committed in regions likely to become more exposed to acute or chronic physical risks
- Percentage of turnover or percentage of CapEx/OpEx substantially contributing to climate adaptation

Following a 2020 consultation on the NFRD, the European Commission adopted a proposal for a Corporate Sustainability Reporting Directive (CSRD). The CSRD is expected to apply from 1 January 2024, subsequent to an agreement between the European Council and Parliament in June 2022, improving the NFRD's existing non-financial reporting requirements. The European Financial Reporting Advisory Group (EFRAG) is setting out European Sustainability Reporting Standards (ESRS) that will specify information to be reported with respect to physical climate risks.

For larger banks, it is also worth noting the European Central Bank's "Guide on climate-related and environmental risks" (ECB 2020a) sets out 13 expectations with regards to the identification, assessment, and reporting of risks. The key takeaways regarding physical risks are, as follows:

- Take into account long-term time horizons to assess the robustness of business strategy against future scenarios
- Take into account the importance of quantitative Key Performance Indicators (KPIs)—though qualitative KPIs may be acceptable in a transition period
- Provide information on materiality of risks, with reference to time frame and impact of risk on strategy and risk profile
- Use risk information to inform client engagement and reflect risks in strategy
- Assess specifically physical risk on operational capacity (Expectation 9)

Specific central banks have also developed guidance around physical risks. Perhaps most importantly for physical risk, the Dutch Central Bank's "Good practice" guide (DNB 2019) underlines the importance of stress testing to assess the materiality of climate risks and using active client engagement to bridge data gaps.

## United Kingdom

The Prudential Regulation Authority (PRA) is responsible for overseeing banks, building societies, credit unions, insurers, and major investment firms, and has released Supervisory Statement SS3/19 and Policy Statement PS11/19, setting out expectations regarding banks' and insurers' management of climate-related risks, including the disclosure of "material" risks via Pillar 3 disclosures. There are few specific details regarding physical risks in these statements, but the PRA's 2020 "Dear CEO" letter, addressing firms' progress in responding to climate risk expectations, provides more detail on the assessment of physical risks:

- Firms should improve their understanding of physical risks and their relationship to financial risks, including risk transmission channels and interaction between multiple lines of businesses, sectors, and geographies.
- Good practices observed with regards to risk management frameworks included firms that "differentiated the foreseeable nature of financial risks that arise from a combination of physical and transition risk factors from tail risks."
- Firms' strategies for mitigating physical risks were more developed than for transition risk.
- Firms had not yet embedded processes to engage with clients or counterparties about physical risk factors.
- With regards to scenario analysis, it may be more useful to analyse longer-term physical climate changes using less granular analysis of the business models.

Finally, the Prudential Regulation Authority published a comprehensive and detailed framework for assessing the financial impacts of physical climate change for the general insurance sector, though the framework and many of the recommendations could be applicable to other financial institutions (PRA 2019c).

## United States of America

The Securities and Exchanges Commission (SEC) is responsible for the regulation of markets, to protect investors and to facilitate capital formation. One of its key mandates is to ensure that public and other regulated companies submit regular financial and non-financial reports. Identifying climate change as a major risk for companies and markets, the SEC published a draft climate disclosure rule in early 2022. This rule explicitly defines climate-related physical risks and requires registrants to specify the nature of material physical risks and the locations of assets impacted by those risks. Furthermore, the proposed rule explicitly requests reporting institutions to disclose risks from specific hazards, including the following:

- Percentage of "buildings, plants or properties" located in flood hazard areas
- Exposure to water stress in sectors that are highly reliant on water such as energy, materials and buildings, and agriculture
- Increased temperatures that might affect outdoor work such as construction, agriculture, or forestry

A consultation process will help to define the depth and types of information expected around the above specific physical hazards, and potentially others such as extreme weather, wildfires, coastal erosion, and sea-level rise (SEC 2022), as well as the financial impact on a firm.

## International Sustainability Standards Board (ISSB)

Established by the International Financial Reporting Standards (IFRS) Foundation in 2021, the ISSB's goal is to set an internationally recognised standard for reporting sustainability and climate-linked information for all firms, including financial institutions. Released in 2022, the ISSB's Exposure Draft of its proposed Climate-related disclosures standard borrows heavily from the framework established by the recommendations of the TCFD, with the advantage of almost five years' experience of TCFD implementation by companies across the economy.

The draft standard recognises the issues that firms, including financial institutions, have faced in developing climate-related physical risk disclosures, with an acknowledgement that challenges of data availability need to be balanced with the disclosure of "information necessary for users to understand the effects of significant climate-related risks and opportunities in an entity's value chain" (IFRS 2022). The standard integrates physical risks throughout, including the following:

- "Area of properties located in 100-year flood zones by property subsector" for real estate (volume B38)
- "Percentage of agricultural products sourced from regions with High or Extremely High Baseline Water Stress" for agriculture (volume B20)

The draft standard underlines the importance of scenario analysis and the need for transparency in describing scenarios, time horizons, inputs, and assumptions. The draft standard proposes one aggregate non-financial metric covering physical risks, "The amount and percentage of assets or business activities vulnerable to physical risks," similar in scope to the TCFD's proposed physical risk metric in its 2021, "Guidance on metrics, targets, and transition plans"—importantly this is a quantitative metric, as explained in Paragraph B15(b) of the Exposure Draft.

# Appendix B. Case studies

## 1. Strategy

### 1.1 Climate-related risks and opportunities, and time horizons

Figure B-1: Barclays PLC, [Climate-related financial disclosures 2021](#) (p. 12)

Clear definition of time horizons, including durations, and how chronic and acute risks may impact across those time horizons. Further granularity in terms of individual hazards may be possible.

| Examples of identified climate physical risks and their potential financial impacts |  | When considering climate-related physical and transition issues, Barclays assesses them through the following short, medium and long term timescales: |            |
|---|--|---|------------|
| <b>Acute physical risk (event-driven)</b><br>S, M, L                                | <ul style="list-style-type: none"> <li>▪ These will impact on credit and market risk associated with counterparties and clients.</li> <li>▪ Barclays' own operational resilience will mitigate against business disruption and damage to assets.</li> <li>▪ Acute physical events are already happening in the short term but will likely continue to occur and become more widespread.</li> </ul> | Short term  | 0–1 year   |
| <b>Chronic physical risk (shifts in climate pattern)</b><br>M, L                    | <ul style="list-style-type: none"> <li>▪ These risks could impact on entire sectors and geographic regions that the bank supports, as well as potentially impacting on the bank's own infrastructure.</li> <li>▪ These shifts in climate pattern are expected to manifest in the longer term.</li> </ul>   | Medium term   | 1–5 years  |
|   |  | Long term   | 5–30 years |

**Figure B-2: Lloyds Banking Group, [Climate report 2021](#) (p. 14)**

Similar to the previous example, this chart shows how the bank has mapped acute and chronic physical risks across time horizons, with examples of the realistic risk transmission pathways.

**Our strategy: Pillar 1**

**The impact of climate risk on the Group's risk profile**

The following table outlines some examples of the different physical and transitional risks and how they may impact the Group, our customers and our suppliers. Additional details regarding the climate risks facing the Group, including the integration of these risks into our ERMF can be found in the Risk Management section (pages 52 to 64).

| Examples of climate risks and potential impacts on Lloyds Banking Group |                           |  |  |  |
|---|---------------------------|--|--|--|
| Driver  | Examples                  | Examples of key risks for Lloyds Banking Group   | Time horizons  |  |
| Transition risk   | <b>Policy &amp; Legal</b> | <ul style="list-style-type: none"> <li>Regulations and legislation intended to support the transition, including bans and/or limitations on existing activities</li> <li>Increased pricing of GHG emissions</li> <li>Enhanced reporting requirements, for example, around emissions</li> </ul>                             | Impacts from new and existing government policies, for example, around energy efficiency standards or the transition to electric vehicles<br>Evolving regulatory standards for the Group's operations<br>The Group's climate-related disclosures are considered to be either insufficient or misleading, including potential 'greenwashing' in product communication                             | Short, Medium, Long<br>Medium, Long<br>Short, Medium, Long |
|   | <b>Technology</b>         | <ul style="list-style-type: none"> <li>Potential climate-related technology challenges including: current technologies becoming obsolete; new technologies not being adopted; or experiencing problems as they are adopted</li> <li>Costs to transition to lower emissions technology</li> </ul>                           | New technology and availability of electric vehicles reduce valuation of existing vehicles<br>Unproven new technologies required across other sectors in order to reduce emissions   | Short, Medium, Long<br>Medium, Long                        |
|   | <b>Market</b>             | <ul style="list-style-type: none"> <li>Changing customer behaviour and shifts in consumer preferences</li> <li>Market evolution to more sustainable business models and investments, including potential 'sustainability bubbles'</li> <li>Increased costs of carbon-intensive and/or sustainable raw materials</li> </ul> | Reduction in asset and company valuations reflecting changes in customer demand, impacting the Group's lending, markets/trading business, investments and equities<br>Increased costs from sustainable materials for Commercial Banking customers  | Short, Medium, Long<br>Medium, Long                        |
|   | <b>Reputation</b>         | <ul style="list-style-type: none"> <li>Increased stakeholder concern or negative stakeholder feedback around supporting the shift to a low carbon economy</li> <li>Increased scrutiny around activities relating to high emissions sectors and products</li> </ul>   | Failure to deliver or sufficiently drive change through the Group's net zero strategy, relating to its financed activities and own operations<br>Adverse coverage of the Group's exposure to high emissions sectors<br>Conduct risk implications from the Group's role in the transition, including potential impacts on mortgage customers, specific sectors, insurance and investment products | Short, Medium, Long<br>Medium, Long<br>Medium, Long        |
| Physical risk   | <b>Acute</b>              | <ul style="list-style-type: none"> <li>Increase in the frequency and severity of extreme weather events, such as floods and storms</li> </ul>  | Damage to properties, impacting our Retail Mortgage business, Commercial Real Estate portfolio or General Insurance<br>Damage to properties within the Group estate, resulting in disruption to the Group's services to customers<br>Disruption to services provided by the Group's suppliers  | Short, Medium, Long<br>Medium, Long<br>Medium, Long        |
|   | <b>Chronic</b>            | <ul style="list-style-type: none"> <li>Long-term shifts in our climate, such as rising average temperatures, rising sea levels and extreme variability in weather patterns</li> </ul>  | Coastal erosion and river inundation impacts our Retail Mortgage business, Commercial Real Estate portfolio or General Insurance<br>Reduced production for Commercial Banking customers as a result of higher temperatures and/or changing weather patterns, for example, lower food or crop yields<br>Changes in longevity of the Group's pension scheme members                                | Long<br>Long<br>Medium, Long                               |

Note: ERMF = Enterprise-wide Risk Management Framework.

**Figure B-3: European Bank for Reconstruction and Development, [TCFD report 2020](#) (p. 16)**

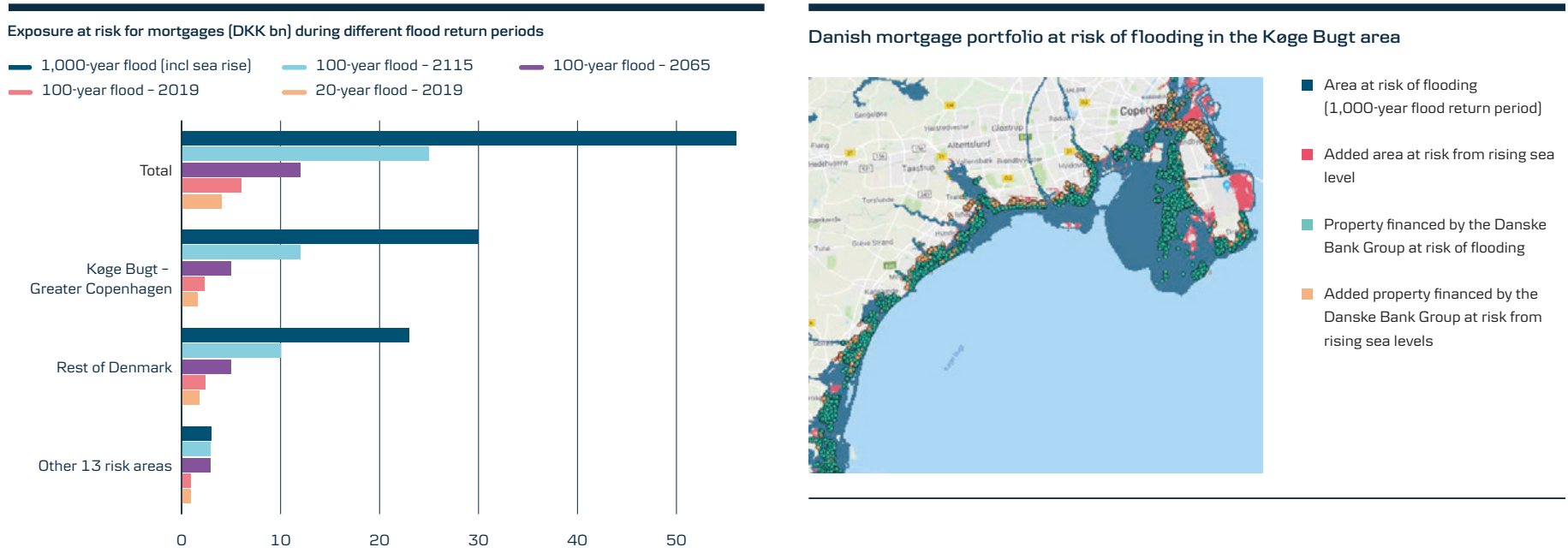
Again, this example provides examples of how acute physical risks may impact clients across time horizons.

Table 4: **Climate risk impact on Banking industry sector groups**

| Risk drivers   | Impact on sector groups   | Timeframe            |
|--|---|----------------------|
| PC risk  |   |                      |
| Slight increase in severity and frequency of extreme weather | <ul style="list-style-type: none"> <li>• More extreme heat events, droughts and floods compared with historical baselines will affect all industry sectors.</li> </ul>  | Short to medium term |
| Frequency and severity of extreme weather worsens            | <ul style="list-style-type: none"> <li>• All industry sectors with exposure to hard-to-adapt sectors, chronic hazards (increasing mean temperature, increasing water stress, sea-level rise) may start to impact assets and business operations.</li> </ul> | Medium to long term  |

**Figure B-4: Danske Bank, [Climate and TCFD progress update](#) (pp. 23–24)**

While this diagram is perhaps more suitable in responding to the scenario analysis question, it does demonstrate how the impact of one acute hazard could increase in severity across three time horizons (2019, 2065, and 2115). While these time horizons are unlikely to be realistic in terms of the bank’s risk management framework, it can be useful to demonstrate that the bank is aware of the increasingly severe impacts of climate change well beyond the time horizons of the majority of its products.



Note: DKK = Danish krone.



**Figure B-5: Munich Re, [Corporate responsibility report 2020](#) (p. 55)**

Here the disclosure identifies potential physical risks per hazard, likelihood, and magnitude—providing greater granularity than the previous examples, which were focused on acute and chronic categories of risks.

| Risks issue  | Time frame, likelihood, magnitude of impact and potential (financial) impact |                      |                        | Response (strategic, financial planning)   |
|--|--|----------------------|------------------------|--|
| <b>Physical: acute &amp; chronic</b>   |  |                      |                        |  |
| Tropical cyclone<br>Example: Atlantic hurricane  | <b>Time frame:</b>   | <b>Likelihood:</b>   | <b>Magn of impact:</b> | <ul style="list-style-type: none"> <li>- Munich Re has a vigilant risk management system in place, capable of detecting and responding to changes in hazard and risk (see details in section risk management).</li> <li>- Annual renewal of most (re)insurance covers allows for high flexibility in adapting risk management and (re)insurance cover conditions over time.</li> <li>- Munich Re's adaption and mitigation measures (see risk management section) also contribute to the prevention of increasing physical risks.</li> </ul> |
|  | Medium-term  | Likely               | High                   |  |
| <b>Potential (financial) impact:</b>   |  |                      |                        |  |
| Increased insurance claims liability, e. g. €6.3bn VaR for Atlantic hurricane (200yrs return period).  |  |                      |                        |  |
| Extra-tropical cyclone<br>Example: Winter storm Europe   | <b>Time frame:</b>   | <b>Likelihood:</b>   | <b>Magn of impact:</b> |  |
|  | Long-term  | Likely               | High                   |  |
| <b>Potential (financial) impact:</b>   |  |                      |                        |  |
| Increased insurance claims liability, e. g. €2.9bn VaR for winter storm Europe (200yrs return period).   |  |                      |                        |  |
| Severe convective storms<br>Example: Severe convective storms USA  | <b>Time frame:</b>   | <b>Likelihood:</b>   | <b>Magn of impact:</b> |  |
|  | Short-term   | Likely               | Medium                 |  |
| <b>Potential (financial) impact:</b>   |  |                      |                        |  |
| Increased insurance claims liability, e. g. €500m-1.5bn (estimated range), VaR for thunderstorm USA (200yrs return period).  |  |                      |                        |  |
| Wildfire<br>Example: Wildfire USA  | <b>Time frame:</b>   | <b>Likelihood:</b>   | <b>Magn of impact:</b> |  |
|  | Short-term   | Very likely          | Medium-high            |  |
| <b>Potential (financial) impact:</b>   |  |                      |                        |  |
| Increased insurance claims liability, e. g. €500m-1.5bn (estimated range), VaR for wildfire USA (200yrs return period).  |  |                      |                        |  |
| Rising sea levels and associated risks such as increased storm surge events  | <b>Time frame:</b>   | <b>Likelihood:</b>   | <b>Magn of impact:</b> |  |
|  | Long-term  | Virtually certain    | High                   |  |
| <b>Potential (financial) impact:</b>   |  |                      |                        |  |
| Increased insurance claims liability. No estimate due to high uncertainties to date.   |  |                      |                        |  |
| Physical risks for MR Group premises   | <b>Time frame:</b>   | <b>Likelihood:</b>   | <b>Magn of impact:</b> | <ul style="list-style-type: none"> <li>- Business-driven risk management and business-continuity plans on a Group-wide and local level apply at all Munich Re Group locations.</li> </ul>  |
|  | Short-term   | More likely than not | Low                    |  |
| <b>Potential (financial) impact:</b>   |  |                      |                        |  |
| Decreased asset value or asset useful life leading to write-offs, asset impairment or early retirement of existing assets. No detailed analysis due to limited likelihood and low magnitude of impact. |  |                      |                        |  |

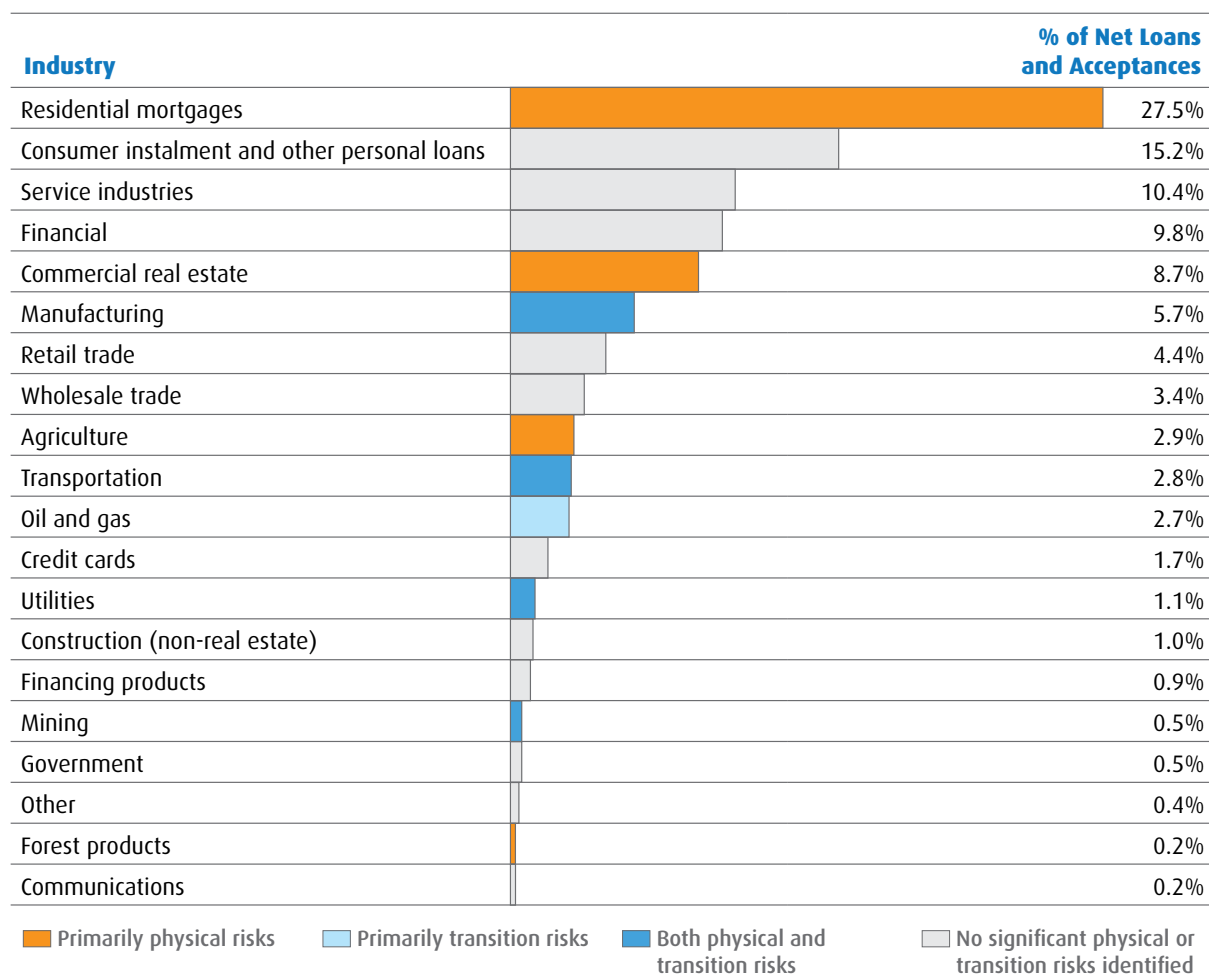
Note: VaR = Value-at-risk.

## 1.2 Business and financial impact

**Figure B-6: BMO Financial Group, [2020 Climate report](#) (p. 6)**

This diagram identifies exposure to climate risks per sector showing how important each sector is to the bank's business, with high physical risk exposure of real estate and agriculture sectors.

### Sensitivity to Climate Risk of BMO Lending Exposures, as at October 31, 2020



**Figure B-7: Banco Santander, [Climate finance report](#) (p. 10)**

This table integrates the identification of physical risks at different time horizons and how they map onto banking risks, which provides insight into how climate risks impact the business over time.

**Climate opportunities over the short, medium and long term**

| Sector / asset                  | Opportunities  | Time Horizon |
|---------------------------------|--|--------------|
| <b>Mortgages</b>                | Green mortgages  | MT           |
|                                 | Lending and advisory offering to help clients identify real estate retrofitting solutions                          | MT           |
| <b>Energy</b>                   | Growth in wind and solar renewable energy financing and advisory   | ST           |
|                                 | Financing for scaling of new technologies such as hydrogen, CCUS , biofuels as well as energy storage more broadly | MT           |
|                                 | Financing and advisory to facilitate EV charging infrastructure build-out  | ST           |
|                                 | Financing and advisory for early-stage companies focused on energy transition-enabling solutions                   | ST           |
| <b>Automotive</b>               | Financing and advisory to enable shift to EVs  | ST           |
|                                 | Financing to establish and integrate battery supply chains   | ST           |
|                                 | Financing of additional technologies that enable low-carbon mobility solutions                                     | ST           |
| <b>Agriculture</b>              | Incentivize and support clients across the value chain to decarbonize and to adopt low-carbon practices            | MT           |
|                                 | Financing and advisory of on-farm emission reduction technologies  | MT           |
| <b>Voluntary Carbon Markets</b> | Provide advisory services and solutions to enable clients to access carbon market opportunities                    | MT           |
|                                 | Offering of green products to individuals and companies with offsetting options                                    | MT           |
| <b>Cross sector</b>             | Growth in green bonds, green loans and sustainability-linked financing instruments                                 | ST           |

Legend: ST: Short-term, MT: Medium-term, LT: Long-term

Notes: MT = Medium term; LT = Long term; ST = Short term.

### Figure B-8: UBS, [Climate report 2021](#) (p. 24)

Quantitative assessment of sector exposure to physical climate risks—although the Risk Management section of the report shows the potential impact on the bank’s portfolio, which may impact business strategy.

#### UBS corporate lending to climate-sensitive sectors – physical risks

| USD million  | As of 31.12.21         |                             | As of 31.12.20                       |                                      | As of 31.12.19                       |
|--|------------------------|-----------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
|  | Trend (%) 2019 to 2021 | Gross exposure <sup>2</sup> | Share of total exposure <sup>2</sup> | Share of total exposure <sup>2</sup> | Share of total exposure <sup>2</sup> |
| <b>Climate-sensitive sector<sup>1</sup></b>                    |                        |                             |                                      |                                      |                                      |
| Aerospace and defence  | ↓                      | 338                         | 0.07%                                | 0.09%                                | 0.48%                                |
| Automotive   | ↓                      | 1,042                       | 0.23%                                | 0.31%                                | 0.26%                                |
| Business services  | ↓                      | 853                         | 0.19%                                | 0.24%                                | 0.25%                                |
| Chemicals  | ↓                      | 991                         | 0.22%                                | 0.44%                                | 0.30%                                |
| Construction and materials                                     | ↓                      | 302                         | 0.07%                                | 0.07%                                | 0.08%                                |
| Consumer products and retail                                   | ↑                      | 650                         | 0.14%                                | 0.10%                                | 0.07%                                |
| Entertainment, leisure and services                            | ↓                      | 1,308                       | 0.28%                                | 0.29%                                | 0.36%                                |
| Food and beverage  | ↑                      | 1,334                       | 0.29%                                | 0.33%                                | 0.25%                                |
| Industrial materials   | ↓                      | 243                         | 0.05%                                | 0.06%                                | 0.12%                                |
| Information technology   | ↓                      | 274                         | 0.06%                                | 0.06%                                | 0.14%                                |
| Machinery and equipment  | ↑                      | 2,732                       | 0.60%                                | 0.61%                                | 0.54%                                |
| Medical equipment and services                                 | ↑                      | 408                         | 0.09%                                | 0.16%                                | 0.08%                                |
| Mining   | ↑                      | 1,153                       | 0.25%                                | 0.21%                                | 0.20%                                |
| Oil and gas  | ↓                      | 5,538                       | 1.21%                                | 1.09%                                | 1.38%                                |
| Pharmaceuticals / biotechnology                                | →                      | 814                         | 0.18%                                | 0.13%                                | 0.18%                                |
| Plastic and rubber   | ↓                      | 280                         | 0.06%                                | 0.08%                                | 0.07%                                |
| Primary materials  | →                      | 320                         | 0.07%                                | 0.07%                                | 0.07%                                |
| Real estate management   | ↑                      | 528                         | 0.12%                                | 0.13%                                | 0.02%                                |
| Sovereigns and financials                                      | ↓                      | 4,371                       | 0.95%                                | 1.06%                                | 1.46%                                |
| Transportation and equipment                                   | ↓                      | 419                         | 0.09%                                | 0.17%                                | 0.22%                                |
| Utilities  | ↑                      | 1,579                       | 0.34%                                | 0.29%                                | 0.33%                                |
| <b>Total exposure to climate-sensitive sectors<sup>3</sup></b> | <b>↓</b>               | <b>25,476</b>               | <b>5.55%</b>                         | <b>5.99%</b>                         | <b>6.87%</b>                         |
| <b>Total exposure to all sectors</b>                           |                        | <b>459,061</b>              | <b>100%</b>                          | <b>437,777</b>                       | <b>373,239</b>                       |

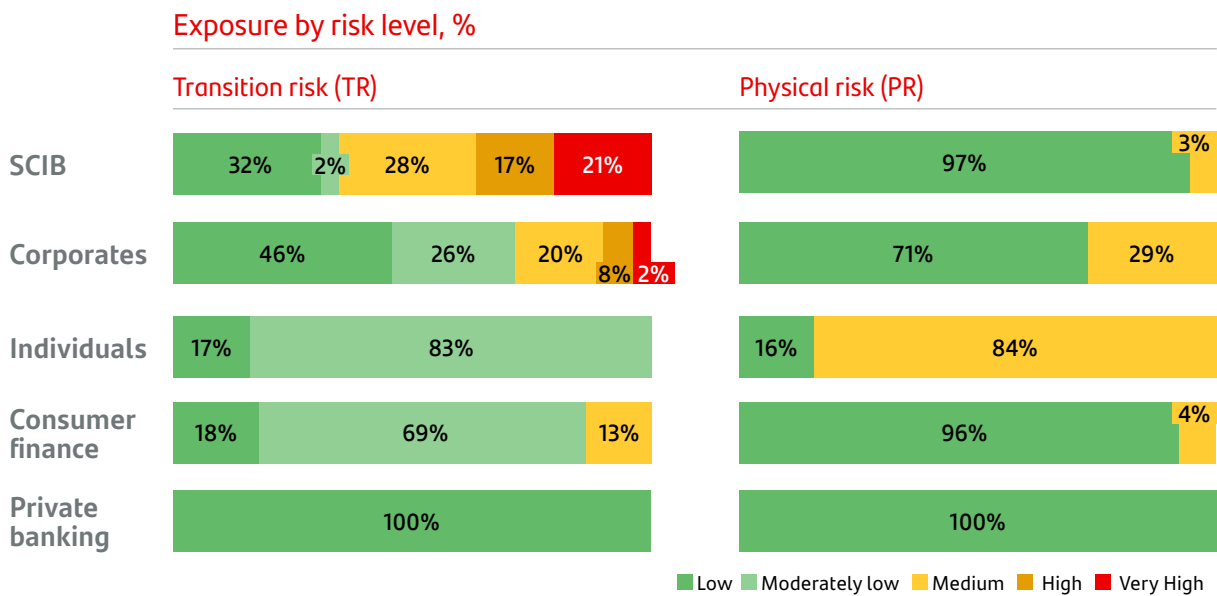
<sup>1</sup> Climate-sensitive sectors are defined as those business activities that are rated as having high, moderately high or moderate vulnerability to transition risks and physical risks. Climate risk analysis is a novel area of research, and as the methodologies, tools and data availability improve, we continue to further develop our risk identification and measurement approaches. <sup>2</sup> Includes total loans and advances to customers and guarantees as well as irrevocable loan commitments (within the scope of expected credit loss). Physical risk number includes USD 4 billion in loans backed by real estate, in regions with elevated climate risks. <sup>3</sup> Global Wealth Management corporate lending to customers represents 1.1% of all on- and off-balance sheet loans and advances to customers, and is excluded from the climate-sensitive sectors analysis in 2021.

**Figure B-9: Banco Santander, [Climate finance report](#) (p. 20)**

Heatmapping can be a highly informative way to identify sectors and/or geographies that are at-risk hotspots, to better focus more resource-intensive scenario analysis. This example shows the agriculture and real estate sectors to be the most exposed, while individuals, that is, retail clients, are most exposed.

**Materiality assessment overview**

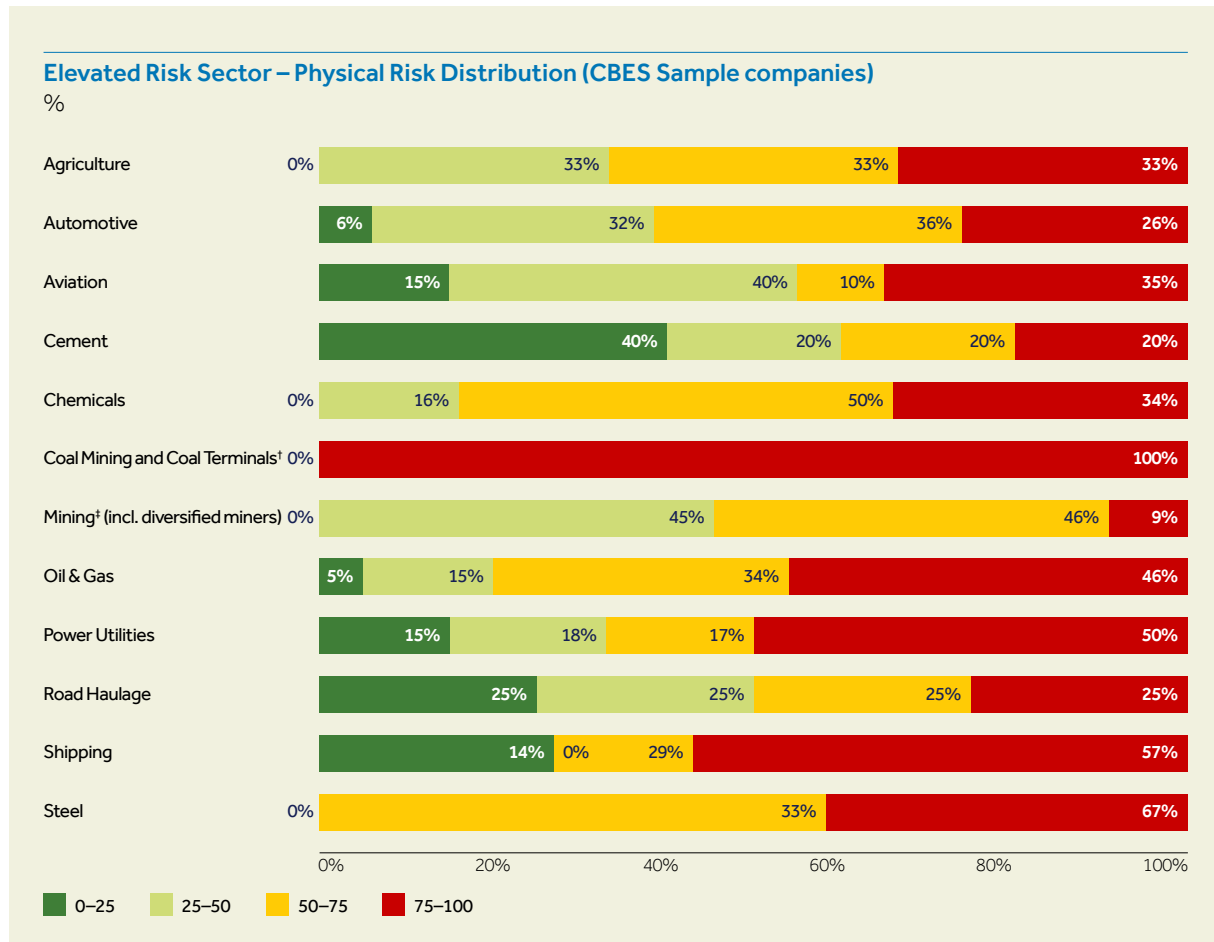
Dec 2020; Credit risk; Inherent risk (before mitigants)



Note: SCIB = Santander Corporate & Investment Banking.

**Figure B-10: Barclays PLC, [Climate-related financial disclosures 2021](#) (p. 27)**

As above, the impacts of physical risk on banking portfolio can be shown in the form of a heatmap, though this graphic is displayed in the report’s scenario analysis section—for this reason, the bank was able to differentiate between low- and high-risk clients within one sector.



Notes: Bank of England climate stress testing exercise, see [bankofengland.co.uk/stress-testing/2022/results-of-the-2021-climate-biennial-exploratory-scenario](https://bankofengland.co.uk/stress-testing/2022/results-of-the-2021-climate-biennial-exploratory-scenario).

CBES = Climate Biennial Exploratory Scenario.

### 1.3 Scenario analysis—process

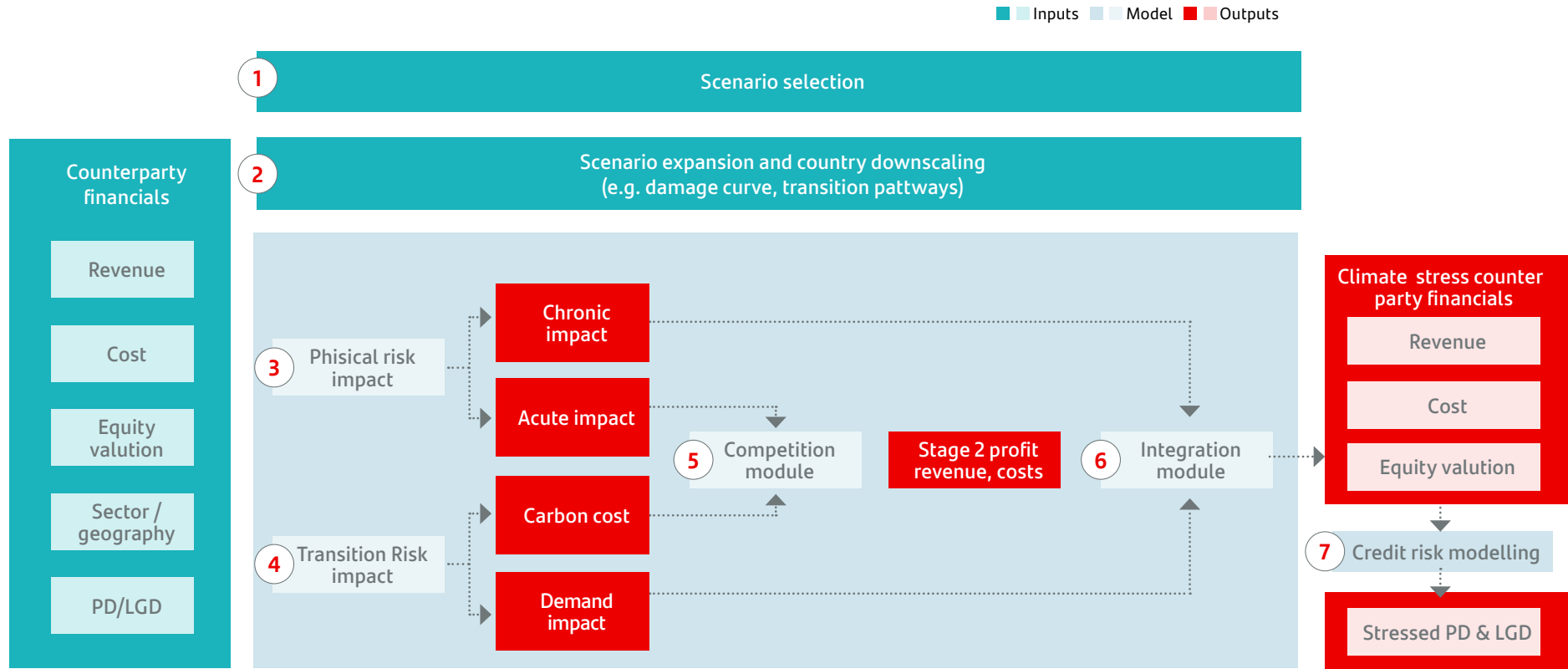
Figure B-11: Moody's, [TCFD report 2021](#) (p. 12)

It is highly important to show clearly what scenarios are being used for physical risk scenario analysis.

| Application  | Physical analysis   |  |  |  |
|--|---|--|--|--|
| Source   | Intergovernmental Panel on Climate Change (IPCC)  |  |  |  |
| Scenario name  | Representative Concentration Pathway 8.5 (RCP 8.5)  | Representative Concentration Pathway 6.0 (RCP 6.0)   | Representative Concentration Pathway 4.5 (RCP 4.5)   | Representative Concentration Pathway 2.6 (RCP 2.6) |
| Description  | A very high GHG emissions scenario with emissions continuing to rise to the end of century. | An intermediate GHG emissions scenario with little additional effort to constrain emissions. | An intermediate emissions scenario with moderate additional effort to constrain emissions. | A stringent mitigation scenario.                   |
| End of century Global Mean Surface Temperature Change relative to 1850–1900 (°C) | 3.7°C   | 2.2°C  | 1.8°C  | 1.0°C  |

**Figure B-12: Banco Santander, [Climate finance report](#) (p. 13)**

This schematic can be useful to show clearly the methodology used for scenario analysis.



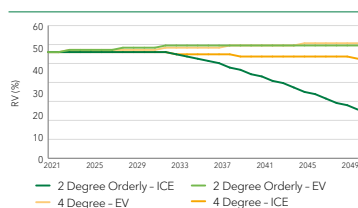
Notes: PD = Probability of Default; LGD = Loss Given Default.



**Figure B-13: Lloyds Banking Group, [Climate report 2021](#) (p. 70)**

Financial institutions should be aware of the uncertainty in scenario analysis, and this is best demonstrated by including a section on limitations and lessons learned from scenario analysis.

**Chart J - RV change of the Motor portfolio**



## Limitations of climate scenario analysis

Climate scenario analysis remains in its infancy; therefore, when conducting analysis of this nature, it is important to set out the current limitations that were observed.

- Long-term time horizons – climate scenarios are typically modelled to a significantly longer time horizon than traditional macroeconomic scenarios and can span multiple decades. In the outputs described previously, the Group had selected a 30-year time horizon, as the Group believed it struck the right balance between longevity and plausibility. However, the longer the time horizon, the greater the uncertainty. This leads to increased difficulty in reliably assessing the risk, especially when combined with finance projections that can accompany scenario analysis (e.g. projections of balance sheet evolution over long time periods)
- Data challenges – climate data continues to develop but gaps were observed across portfolios. These included reliance on self-reported emissions by individual companies, which predominantly captured only Scope 1 and 2 emissions, missing the larger value chain Scope 3 emissions. Some EPC data was missing requiring gaps to be filled through a proxy waterfall method

- Modelling – climate modelling is very complex and its application in financial risk assessment is in its infancy, for example where some effects are not captured. As the usage of scenario analysis increases, the modelling will mature and the Group will continue to enhance its capabilities

These limitations are not set out to negate the value of these initial assessments undertaken but to contextualise them and provide perspective to the outputs. The Group recognises the importance of mitigating these limitations to the extent possible and is working together with its clients to better understand emission profiles and transition strategies to improve data disclosures, as well as working with its peers in the financial sector to better understand, provide feedback and improve on modelling evolution and accuracy.

## Evolution of climate scenario analysis

As the understanding and importance of climate risk has progressed, climate scenario analysis has become an increasingly important risk management tool assisting in the identification, measurement and ongoing assessment of climate risks that pose threats to the Group's strategic objectives. It is a fast-evolving discipline, requiring new skills and capabilities to be established with appropriate levels of governance.

The Group considers that the key areas of evolution for climate scenario analysis will evolve around:

- Scope evolution:
  - Supporting understanding and the decision-making of businesses, including extending counterparty engagement on transition strategies across different potential pathways

- Continuing to shape the overall Group's net zero strategy, and designing Group internal base and stress scenarios to better understand the climate risks and opportunities in key sectors
- Meeting additional regulatory stress test exercises e.g. potential CBES second round and any future regulatory requirements
- Enhance capabilities in line with the evolution of regulatory embedding of climate risks in capital frameworks
- Technical evolution:
  - Improvements to climate-related data (e.g. gathering EPCs, Scope 3 emissions) to improve scenario analysis modelling
  - Enhancing risk management toolkits, methodologies and models to enhance portfolio monitoring

## Capabilities developed from undertaking the CBES

### Background

Participating in the Bank of England's CBES exercise enabled the Group to explore the resilience of its credit portfolios under three different climate scenarios (early policy action, late policy action, no additional policy action) over the next 30 years to 2050. The CBES exercise was intended to be a learning exercise and the key learnings the Group took away are described in the following section.

### Summary of key learnings

- Climate risk understanding – the CBES required the mobilisation of many internal stakeholders across the Group up to and including the Board. Extensive climate risk training and discussion of the results enabled all stakeholders to build their understanding of the impact of climate risk and provided a robust and effective review and challenge of the results
- Modelling capability – the exercise advanced the Group's technical capabilities in climate risk modelling and long-term scenario analysis through better understanding of climate model uncertainties and linking climate transition pathways and hazard impacts on asset valuations with financial assessment models that capture impairment and fair value changes. This end-to-end modelling capability and connection with traditional credit stress test techniques provided deeper insights on the vulnerability of existing business models to future climate pathways
- Business strategy – consideration of the performance of existing business models under different climate conditions underscored the need to create feedback loops from scenario analyses to ensure strategic climate risk drivers are more deeply embedded in strategy discussions and business planning. This provided insights on the strategic drivers of management actions, across diverse scenarios, and their timing
- Client engagement – the bottom-up legal entity modelling required by the CBES provided an opportunity to engage further with counterparties to better understand their climate adaptation plans, identify how the Group could support them and, hence, help clients recover through accelerating the transition to a low carbon economy
- Data – gathering climate-related data describing the climate profile of clients is a key area of improvement needed across the industry. While sourcing external data sets remains an important method to acquire data, the additional contact with clients was a more valuable way of gathering climate-related data, enabling the information to be placed into the context of the clients' adaptation plans and business strategy evolution

Notes: CBES = Climate Biennial Exploratory Scenario; EPC = Energy Performance Certificate (for mortgages); EV = Electric Vehicles; ICE = Internal Combustion Engine; RV = Residual Value; LGD = Loss Given Default.

## 1.4 Scenario analysis—Modelling and results

Figure B-14: European Bank for Reconstruction and Development, [TCFD report 2020](#) (p. 18).

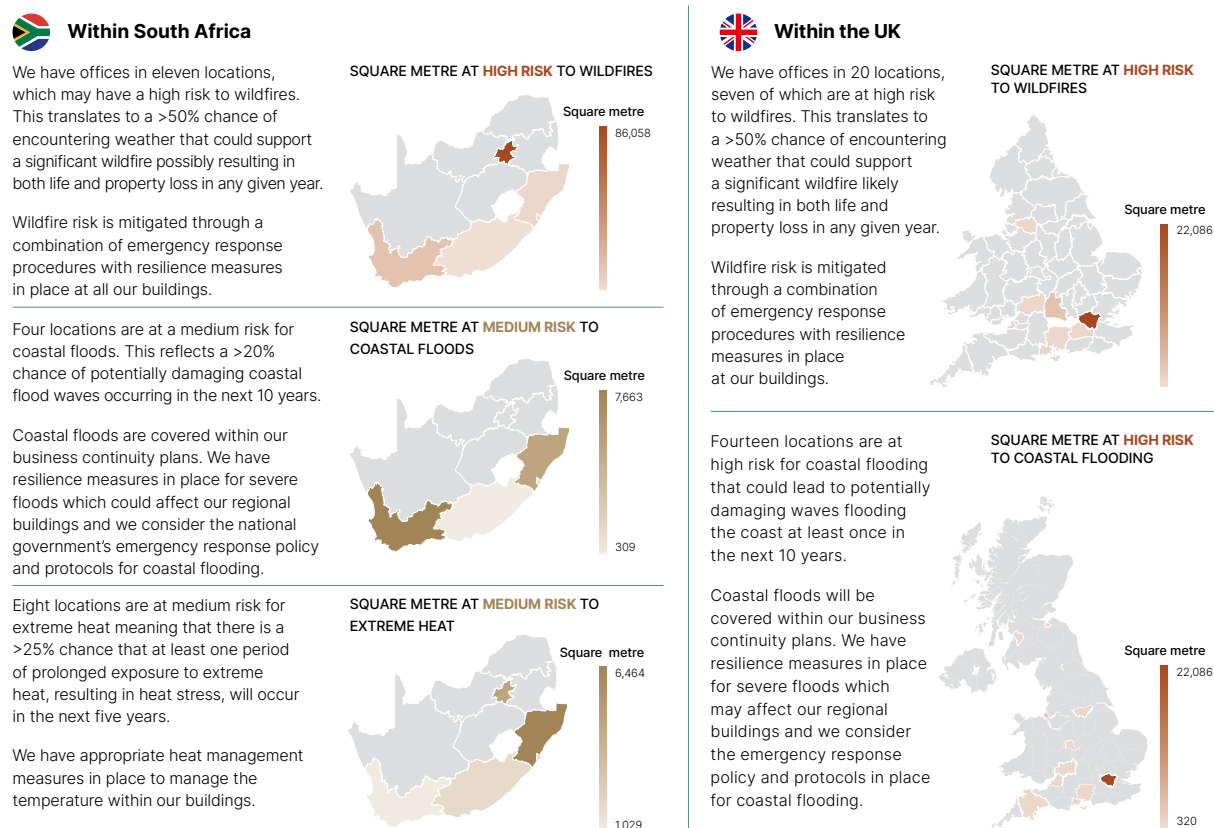
Demonstrating the output of scenario analysis can be a useful visual aid provided there is transparency around the data sources, methodology, and risk metrics.

Table 5: **PC hazards and data sources**

| Category            | Chronic or acute | PC hazard                    | Data source   |
|---------------------|------------------|------------------------------|---|
| Temperature related | Chronic          | Increasing mean temperatures | Swiss Re – CatNet                                   |
|                     | Acute            | Extreme heat event           | World Bank – Climate Change Knowledge Portal (CCKP) |
|                     |                  | Wildfires                    | Swiss Re – CatNet                                   |
| Wind related        | Acute            | Extreme wind event           | Swiss Re – CatNet                                   |
| Water related       | Chronic          | Increasing water stress      | WRI – Aqueduct                                      |
|                     |                  | Sea-level rise               | Climate Central – Coastal Risk Screening Tool       |
|                     | Acute            | Drought                      | World Bank – Climate Change Knowledge Portal (CCKP) |
|                     |                  | Flood                        | Swiss Re – CatNet                                   |
| Solid mass related  | Chronic          | Erosion                      | Swiss Re – CatNet                                   |
|                     | Acute            | Extreme mass movement        | Swiss Re – CatNet                                   |

Alongside the scenarios used, financial institutions should demonstrate transparency in their data sources for physical risk analysis as demonstrated by the wide range of sources used below.

Figure B-15: Investec, [Climate-related financial disclosures 2021](#) (p. 37)



## Figure B-16: AIB, [Climate & environment report 2021](#) (p. 31)

Outline methodology of physical risk assessment for flooding of mortgage book, alongside graphic showing flood risk across key geography.

(i) **Geolocation of the AIB residential mortgage book** using latitude and longitude. Properties were matched to building, street, village, townland etc. based on address data available;

ii) **Flood data level projections** (river, coastal, pluvial flooding, baseline & various RCPs) were obtained for each geo-location for a range of flood severities or "return periods" (e.g. flood projections for a 1-in-75 return period characterise flood levels that would occur with a 1-in-75 year frequency). The flood data provided is on an undefended basis (other than standard sewage defences); the Office of Public Works (OPW) currently only permits members of the Insurance Institute of Ireland access their defended areas data. The flood projections for this range of return periods are then used to calibrate probability distributions with respect to flood levels for each property;

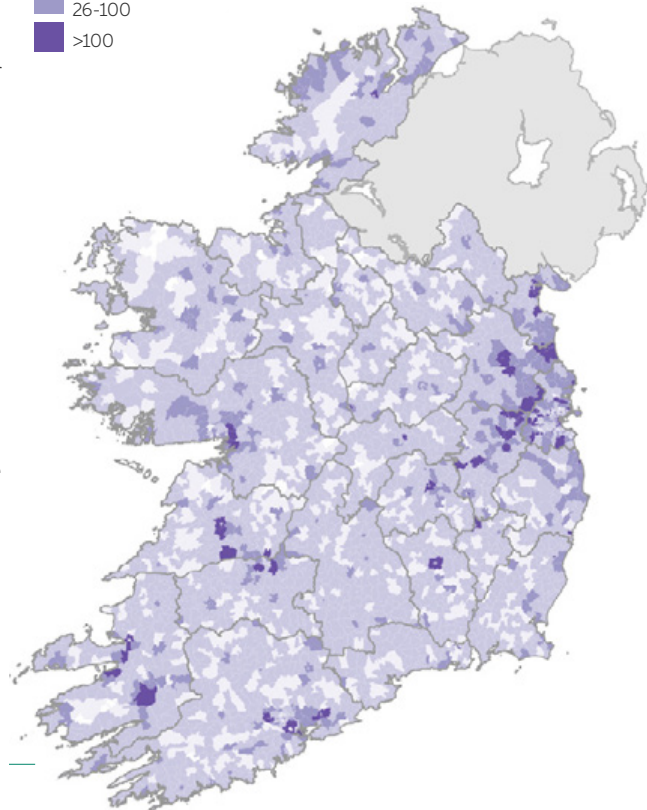
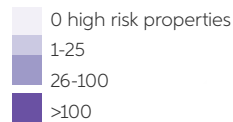
(iii) **Determining the property type** (detached, semi-detached, bungalow etc);

(iii) "Vulnerability Functions"<sup>3</sup> were then used to **translate flood level distributions into probability distributions for "damage-ratios"** (i.e. the cost of repairing flood damage, as a percentage of house prices).

In the model, the insurance coverage ratio is set to 94%, so that when a flood event occurs, 94% of the damage to the property is assumed to be covered by the insurer, and only 6% of the damage will cause a loss in the property value. This assumption is based on the discussions with the internal insurance team and market practices.

**Map 1:** High level overview of Electoral Divisions ("ED") with significant flood risk (i.e. >25cm) in 2080 RCP 8.5 1-in-200 year return period

# AIB properties per ED with high flood risk



**Figure B-17: Macquarie, [Macquarie and climate change: TCFD implementation progress and scenario analysis](#) (p. 15)**

The chart below shows how the bank maps physical risks onto financial valuation drivers in the case of wind farms. This can be useful in showing the methodology behind analyses.

**TRANSMISSION CHANNELS LINKING CLIMATE HAZARDS TO FINANCIAL VALUATION DRIVERS (WIND ENERGY EXAMPLE)**

| Hazards                                      | Transmission channels                           | Impacts to valuation drivers |
|--|---|------------------------------|
| <b>Changes to windstorms</b>                 | Wind turbine damage/ failure → Outage to repair | ● Plant yield                |
|  | → Physical damage                               | ● O&M cost                   |
| <b>Changes in rain / ice conditions</b>      | Erosion of turbine blades                       | ● Plant yield                |
|  | Ice accumulation on blades                      | ● O&M cost                   |
| <b>Changes in average wind speed</b>         | Reduced power output                            | ● Plant yield                |
|  | → Impact on contracts                           | ● O&M cost                   |
|  | Increased power output                          | ● Plant yield                |
| <b>Sea level rise / increased windstorms</b> | → Greater wear and tear                         | ● O&M cost                   |
|  | → Impact on foundations                         | ● Plant life                 |

● Quantified impacts      ● Qualitative / narrative

Note: O&M = Operation & Maintenance.

## Figure B-18: Macquarie, [Macquarie and climate change: TCFD implementation progress and scenario analysis](#) (p. 16)

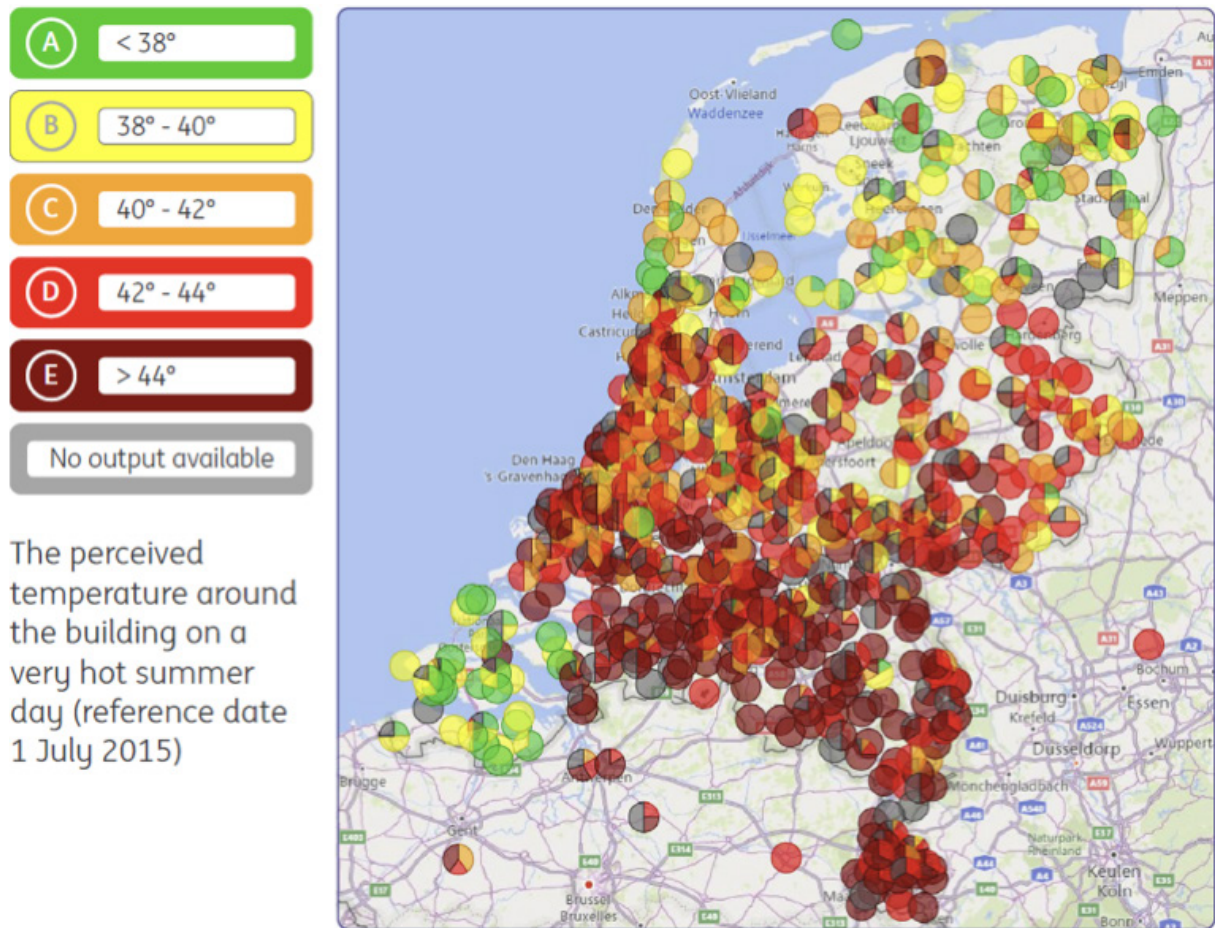
Summary of inputs to and outcomes from physical risk scenario analysis of exposure to wind farms is a useful description of the scenarios used, the physical impacts, and how they translate into business impacts.

### Physical risk scenario analysis for equity exposure to onshore and offshore wind farms

|                 |   |
|-----------------|---|
| <b>Scope</b>    | The analysis focused on prototypical windfarm assets in Australia, Japan, Taiwan and Norway.  |
| <b>Impacts</b>  | <p><b>Japanese assets (on and offshore)</b></p> <ul style="list-style-type: none"> <li>Under present day climatic conditions, tropical cyclones were identified as the key acute climate hazard for the prototypical assets, while sea level rise and changes to average wind speed were identified as the key chronic climate hazards.</li> <li>By the 2050s under the RCP 8.5 pathway, model simulations projected: <ul style="list-style-type: none"> <li>Increases in the frequency of tropical cyclones<sup>6</sup> including Category 4 and 5 typhoons.</li> <li>No change or a small reduction in annual mean wind speeds<sup>7</sup> and sea level rise of approximately 40cm compared to the IPCC baseline.</li> </ul> </li> </ul> <p><b>Australian assets (onshore)</b></p> <ul style="list-style-type: none"> <li>Under present day climatic conditions, the prototypical assets were not exposed to material acute hazards such as windstorms or tropical cyclones, however if located in a flood zone the assets could experience a current day flooding impact. Changes to average wind speed were identified as the key chronic climate hazards for these assets.</li> <li>By the 2050s under the RCP 8.5 pathway, model simulations projected: <ul style="list-style-type: none"> <li>No material change to the acute climate hazards compared to present day.</li> <li>A potential reduction in average wind speeds, however under the RCP 2.6 pathway a potential increase in average wind speed was projected.</li> </ul> </li> </ul> <p><b>Taiwanese assets (offshore)</b></p> <ul style="list-style-type: none"> <li>Under present day climatic conditions, tropical cyclones were identified as the key acute climate hazard for the prototypical assets, while sea level rise and changes to average wind speed were identified as the key chronic climate hazards.</li> <li>By the 2050s under the RCP 8.5 pathway, model simulations projected: <ul style="list-style-type: none"> <li>Increases in the frequency of tropical cyclones<sup>6</sup> including Category 4 and 5 typhoons.</li> <li>No change or a small reduction in annual mean wind speeds<sup>7</sup> and sea level rise of approximately 40cm compared to the IPCC baseline.</li> </ul> </li> </ul> <p><b>Norwegian assets (onshore)</b></p> <ul style="list-style-type: none"> <li>Under present day climatic conditions, windstorms were identified as key acute climate hazards for the prototypical assets, and if located in a flood zone the assets could experience a current day flooding impact. Changes to average wind speed were identified as the key chronic climate hazard.</li> <li>Under the RCP 8.5 pathway, model simulations indicated: <ul style="list-style-type: none"> <li>Little evidence of changes in acute European windstorm activity for the prototypical assets over the modelled time horizons.</li> <li>Potential decrease in frequency of river flood events by 2050s.</li> <li>Slight reduction in average wind speeds by 2050s.</li> </ul> </li> </ul> |
| <b>Outcomes</b> | <p>For the onshore and offshore windfarms prototypical assets, analysis was conducted to understand potential valuation impacts resulting from changes to yield and operation and maintenance costs (defined to include opex and maintenance capex) as a result of the chronic and acute climate hazards described above. Not all transmission channels could be quantified due to the nature and scope of this study, but consideration was given to these when interpreting the analysis.</p> <p>The modelling demonstrated the site-specific nature of the impacts, with any potential changes to net asset values dominated by chronic changes in average wind speeds. By 2050, under both the RCP 2.6 and 8.5 scenario, the modelling suggested very limited impact to net asset values for the Taiwanese, Norwegian and Australian prototypical assets. The Japanese assets were more exposed to the quantified chronic hazards with potential reductions in yield projections that implied a small decrease in net asset values by 2050 under both scenarios.</p> <p>Broadly, the book values of the assets remained robust to the quantified impacts of physical climate risk. This assumes adequate insurance coverage for acute events throughout asset life.</p>   |

**Figure B-19: ING, [Climate risk report 2020](#) (p. 21)**

The output, shown below, from an analysis of heat stress impacts, shows the geographical reach of the analysis and specifies the semi-quantitative risk category thresholds in terms of degrees Celsius.



The perceived temperature around the building on a very hot summer day (reference date 1 July 2015)

## 2. Risk Management

### 2.1 Risk identification and assessment

Figure B-20: Bank of America, [Responsible growth and a low-carbon economy](#) (p. 15)  
Mapping of the impact of physical climate risks across banking risks

| Risk Type           | Risk Type Definition  | Physical Risk  | Transition Risk   |
|---------------------|---|--|---|
| <b>Credit</b>       | Risk of loss arising from the inability or failure of a borrower or counterparty to meet its obligations  | Impacts on repayment capacity and collateral values  | Financial impacts from policy, legal, technology or market changes  |
| <b>Market</b>       | Risk that changes in market conditions may adversely impact the value of assets or liabilities or otherwise negatively impact earnings  | Impacts to asset valuations; secondary exposure to insurers  | Impacts to market prices  |
| <b>Liquidity</b>    | The inability to meet expected or unexpected cash flow and collateral needs while continuing to support our businesses and customers under a range of economic conditions   | A run on deposit balances, unexpected increases in unfunded commitments and decrease in access to funding providers  | Impacts on clients' liquidity needs   |
| <b>Compliance</b>   | Risk of legal or regulatory sanctions, material financial loss or damage to the reputation of the bank arising from the failure of the bank to comply with the requirements of applicable laws, rules and regulations, and our internal policies and procedures   | Workplace disruptions from extreme weather events impact our ability to comply with internal policies and procedures | Direct impacts of new climate-related regulations on bank operations  |
| <b>Operational</b>  | Risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events  | Impact of extreme weather events on facilities, employees, or vendors  | Impact of regulatory changes on internal processes or vendors   |
| <b>Strategic</b>    | Risk resulting from incorrect assumptions about external or internal factors; inappropriate business plans; ineffective business strategy execution; or failure to respond in a timely manner to changes in the regulatory, macroeconomic or competitive environments in the geographic locations in which we operate | Impact of incorrect assumptions, inadequate planning, or poor strategy execution regarding climate-related risk      | Impact of untimely response to changes in regulatory or market environments   |
| <b>Reputational</b> | The risk that negative perceptions of the bank's conduct or business practices may adversely impact its profitability or operations   | Impact of perceived inadequate management of climate-related risks on our operations                                 | Impact of client and shareholder perceptions regarding fossil fuel financing or lack of progress toward climate commitments |

Figure B-21: Lloyds Banking Group, [Climate report 2021](#) (p. 55)

| Examples of climate change impacts across other principal risks |  |  |
|---|--|--|
| Key risk types impacted   | Driver   | Examples of key risks for Lloyds Banking Group   |
| Strategic   | Reputation   | <ul style="list-style-type: none"> <li>Failure to deliver or sufficiently drive change through the Group's net zero strategy, relating to its financed activities and own operations</li> </ul>  |
| Credit  | Policy & Legal<br>Technology<br>Market<br>Reputation<br>Physical (Acute / Chronic) | <ul style="list-style-type: none"> <li>Impacts from new and existing government policies, for example, around energy efficiency standards or the transition to electric vehicles</li> <li>New technology and availability of electric vehicles reduce valuation of existing vehicles</li> <li>Unproven new technologies required across other sectors in order to reduce emissions</li> <li>Reduction in asset and company valuations reflecting changes in customer demand, impacting the Group's lending</li> <li>Increased costs from sustainable materials for Commercial Banking customers</li> <li>Adverse coverage of the Group's exposure to high emissions sectors</li> <li>Flood damage to properties or coastal erosion, impacting our Retail Mortgage business or Commercial Real Estate portfolio</li> <li>Reduced production for Commercial Banking customers as a result of higher temperatures and/or changing weather patterns, for example, lower food or crop yields</li> </ul> |
| Market  | Market<br>Physical (Chronic)   | <ul style="list-style-type: none"> <li>Reduction in asset and company valuations reflecting changes in customer demand, impacting the Group's markets/trading business, investments and equities</li> <li>Changes in longevity of the Group's pension scheme members</li> </ul>  |
| Insurance underwriting  | Physical (Acute / Chronic)   | <ul style="list-style-type: none"> <li>Potential for increased levels of General Insurance claims due to damage to property caused by changes to weather patterns and climate (e.g., flood, storm, coastal erosion)</li> </ul>   |
| Conduct   | Reputation<br>Policy & Legal   | <ul style="list-style-type: none"> <li>Conduct risk implications from the Group's role in the transition, including potential impacts on mortgage customers, specific sectors, insurance and investment products</li> <li>The Group's climate-related disclosures are considered to be either insufficient or misleading, including potential 'greenwashing' in product communications</li> </ul>  |
| Operational resilience  | Physical (Acute)   | <ul style="list-style-type: none"> <li>Damage to properties and systems within the Group estate, resulting in disruption to the Group's services to customers</li> <li>Disruption to services provided by the Group's suppliers</li> </ul>   |
| Regulatory & Legal  | Policy & Legal   | <ul style="list-style-type: none"> <li>The Group's climate-related disclosures are considered to be either insufficient or misleading, including potential 'greenwashing' in product communications</li> <li>Evolving regulatory standards for the Group's operations</li> </ul>   |



## 2.2 Risk management process

Figure B-22: Lloyds Banking Group, [Climate report 2021](#) (p. 57)

Mapping of climate change risks across an organisation's risk management policies, identifying risk management measures, and how far they have been implemented, including the management of physical risks under mortgage credit risk policy.

| Consideration of sustainability and climate risk in our credit policies |                    |                                      |  |  |
|---|--------------------|--------------------------------------|--|--|
| Policy  | Segment coverage   | Risks addressed                      | Key controls / mitigation measures included in the policy  | Status of implementation   |
| Group Credit Risk Policy  | Group-wide         | Climate and sustainability risks     | <ol style="list-style-type: none"> <li><b>Sustainability Risk</b> - Must be considered for all new/renewal credit applications (thresholds apply).</li> <li><b>Equator Principles</b> - Must be adhered to for all Project Finance/Project-related facilities.</li> <li><b>Collateral/Valuations</b> - Due regard must be paid to sustainability/environmental legislation.</li> </ol>   | Implemented  |
| Commercial Banking Credit Framework Policy                              | Commercial Banking | Climate and sustainability risks     | <ol style="list-style-type: none"> <li><b>External Sector Statements</b> - All business must comply with external sector statements.</li> <li><b>Sustainability Risk</b> - As above, and including understanding of clients approach to transition/physical risks, reduction of greenhouse gases, stranded assets and compliance with relevant legal/regulatory ESG requirements.</li> <li><b>Environmental Risk Assessment</b> - Completed for relevant clients/transactions.</li> <li><b>Soft Commodities Compact</b> - Adhere to standards of compact.</li> <li><b>Equator Principles</b> - As above.</li> <li><b>Counterparty Level Risk Assessment</b> - Use assessment (where available) to inform credit profile for new/renewal applications.</li> </ol> | Implemented/Counterparty Level Risk Assessment - ongoing development |
| Commercial Banking ESG Credit Risk Policy                               | Commercial Banking | Climate and sustainability risks     | Encapsulates all climate and sustainability risk requirements in one policy, expanding on the activities expected of the business and credit.  | New policy - published in Dec-21                                     |
| Commercial Banking Sector Policies                                      | Commercial Banking | Climate and sustainability risks     | Sustainability guidance/mandatory requirements are being embedded into all appropriate sector policies, in particular high carbon intensive sectors identified as part of the sector review process, as detailed on page 61, e.g. oil and gas, utilities, automotives etc.   | Embedded into >15 policies, with further policies in scope for 2022  |
| Mortgage Credit Risk Policy   | Retail             | Energy efficiency and physical risks | <ol style="list-style-type: none"> <li><b>EPC Controls</b> - In place for buy-to-let properties, to ensure all lending meets regulatory requirements.</li> <li><b>Physical Risk</b> - Exposure to physical risks (such as flooding) considered in our mortgage origination criteria/property valuation process. To help determine the adequacy of mitigation/abatement measures, higher-risk cases are subject to a thorough site inspection by technical experts (also considered within Commercial Real Estate policies).</li> </ol>   | Implemented  |
| Motor Credit Policies   | Retail             | Transition risk                      | EV strategy fully aligned with Risk Motor policy to ensure the pace and quality of growth is understood and regularly reviewed to ensure risks remain within appetite.   | Implemented  |

Notes: EPC = Energy Performance Certificate; ESG = Environmental, Social, Governance; EV = Electric Vehicles.

**Figure B-23: Standard Chartered, [Facilitating climate action where it matters most](#) (p. 49)**

Materiality assessment in terms of physical risk impact on credit risk (Consumer, Private, and Business Banking [CPBB]). This example is taken from the Risk Management section of the bank’s report, as it goes on to show how the bank is managing those physical risks and how they are integrated into the overall risk management framework.

| Climate risk drivers                                 | Potential impacts to credit-worthiness of some borrowers  | Existing credit risk mitigation measures in place which inherently address climate risk  | Additional climate risk-specific actions being undertaken   |
|--|---|--|---|
| <p><b>Impact of physical risk on collaterals</b></p> | <p>Potential for decrease in collateral/asset valuation, leading to increased PD and Loss Given Default (LGD)</p> <ul style="list-style-type: none"> <li>• Impacts of acute weather risks such as property damage</li> <li>• Loss of insurance coverage or increase in insurance premiums to account for future climate change</li> </ul> | <ul style="list-style-type: none"> <li>• Established collateral management processes with periodic monitoring and oversight</li> <li>• For new loans, robust property valuation process</li> <li>• Geographic diversification and low average loan to value (LTV) ratios (around 45 per cent), which allows headroom to absorb decreases to property valuation</li> <li>• Periodically refreshed Credit Approval Documents (CADs) that help in establishing risk acceptance criteria for our portfolios in each market</li> <li>• Quarterly Portfolio Quality Reviews (PQR) to review the outlook of the economic and operating environment, portfolio quality indicators, and performance against risk appetite triggers and thresholds</li> <li>• Capital adequacy is ensured through both pillar 1 (majority of which is informed by Internal Ratings Based models) and pillar 2 capital requirements (driven by severe but plausible stress scenarios, typically a 5-year scenario covering macroeconomic shocks and downturn)</li> <li>• While mortgages are typically long tenor products, the average actuarial tenor is around 5-7 years, which allows us time to update our strategy should physical risks deteriorate rapidly</li> </ul> | <ul style="list-style-type: none"> <li>• Completed analysis of physical risk profile for majority of residential mortgage portfolios at a property level</li> <li>• Over 2021, initiate coverage of physical risk concentration in mainstream retail risk reporting forums (such as PQR), and discuss necessary adaptation measures</li> <li>• By end of 2021, leverage the physical risk insights in the periodic refresh of CADs to inform location strategy</li> <li>• Over 2021, expand the understanding of impact of adaptation measures on physical risk ratings and the potential financial impact through collateral valuation impact</li> </ul> |

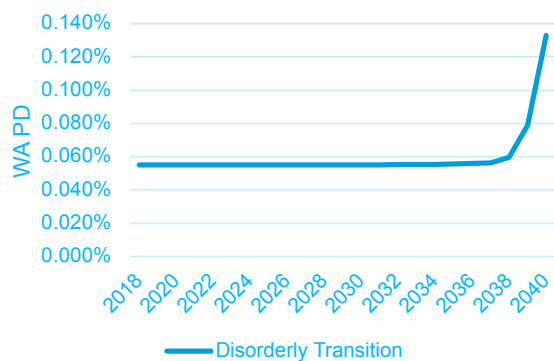
**Figure B-24: Standard Chartered, [Facilitating climate action where it matters most](#) (p. 47)**

A key component of managing climate risks for banks is client engagement. The example below shows output from a client engagement questionnaire, including physical risks.

| Questionnaire Categories |                             | Scoring | Client Assessment  |
|--------------------------|-----------------------------|---------|--|
| 1                        | Governance & Disclosures    | 75%     | <ul style="list-style-type: none"> <li>Client scores well on overall linkage to governance and strategy</li> <li>Acknowledge climate related risks, have board level oversight and policy committed to manage climate change; publishes fully aligned TCFD disclosures</li> </ul>  |
| 2                        | Gross Physical Risk         | 50%     | <ul style="list-style-type: none"> <li>~50% of client's operating locations exposed to extreme flood risk leading to the low score</li> <li>On a forward looking basis, locations exposed to extreme flood risk and heat stress</li> </ul>   |
| 3                        | Physical Risk Adaptation    | 60%     | <ul style="list-style-type: none"> <li>Client's risk management systems are designed to assess potential physical risks to its operations and assets, and evaluation of the adequacy of safeguards.</li> <li>Client has invested in raising dikes and construction of sea walls to protect their facilities against possible storm surges,</li> </ul>  |
| 4                        | Gross Transition Risk       | 38%     | <ul style="list-style-type: none"> <li>Based on it's current emissions client has a temperature alignment of 4.43 degrees driven by it's business model including high reliance of fossil fuels and is in line with peers</li> <li>Client is expected to face a significant shift in PD under a disruptive transition scenario while only a 2 notch shift in an orderly transition</li> </ul>  |
| 5                        | Transition Risk Mitigation* | 76%     | <ul style="list-style-type: none"> <li>Client has pledged it's support to align its business operations to the goals of the Paris Agreement</li> <li>Client reports on all scope 1, 2, and 3 emissions also has short term emission reduction targets</li> <li>Client has a clear energy transition focus on lower carbon intensity, increased renewables in their business and investing in future through breakthrough technologies</li> </ul> |

### PD migration in a disruptive disorderly transition scenario

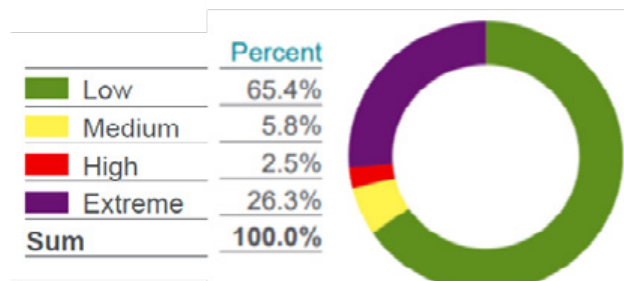
PDs are significantly impacted once carbon price crosses \$200 threshold, which is reflected in the low gross transition risk score above.



### Physical risk profile with a focus on flood risk



### Flood Risk Score – Distribution



Notes: PD = Probability of Default; WAPD = Weighted Average Probability of Default

**Figure B-25: Standard Chartered, [Facilitating climate action where it matters most](#) (p. 52)**

Physical climate impacts on a financial institution’s own operations should be included in a climate risk disclosure report.

| Climate risk drivers   | Potential impacts to areas of operational risk   | Existing operational risk mitigation measures in place which inherently address climate risk   | Additional climate risk-specific actions being undertaken   |
|--|--|--|---|
| <b>Physical risk impacts on our premises and physical assets</b>     | Extreme floods or storms impacting our offices or branches, leading to repair costs, regulatory penalties and employee safety concerns   | Structural mitigation: each building typically has structural adaptation plans (e.g. most buildings exposed to extreme flooding include a basement to partially mitigate impacts of flash flood)<br><br>Financial mitigation: we have extensive buildings insurance in place | Completed physical risk profiling of all our operating locations (branches and offices), and discussed the risk profile at various risk committees<br><br>Included physical risk quantification as part of our new building acquisition checklist, meaning physical risk is explicitly considered for any new building that we acquire globally |
| <b>Physical risk impacts on our client service processes</b>         | Extreme floods or storms at multiple locations impacting our business continuity plans with consequent impact to services we provide to clients (e.g. transaction processing)  | Our critical operating locations have business continuity plans which include alternative geographically diversified sites (e.g. there are plans for critical processes out of Chennai to split operational delivery between Bangalore, Kuala Lumpur or Tianjin)             | Approach to be developed over 2021, leveraging our physical risk assessment capabilities  |
| <b>Physical risk impacts on critical third-party vendor services</b> | Extreme floods or storms impacting the location from which our critical third parties provide their services (including back-up locations and their business continuity plans) | Critical third parties are required to have their internal business continuity plans   |   |

## 2.3 Integration of climate risk into risk management frameworks

Figure B-26: Barclays PLC, [Climate-related financial disclosures 2021](#) (p. 32)

Framework showing integration of climate risks (both physical and transition) into the overall climate risk framework, including who is responsible for managing each of these risks.

| Governance       |   | Enterprise Risk Management Framework (ERMF)   |   |  |  |  |
|------------------|---|---|---|--|--|--|
|                  |   | Climate Risk Framework  |   |  |  |  |
| Responsibilities | Climate risk  | Climate Change Financial Risk and Operational Risk Policy   |   |  | Climate Change Standard  |  |
|                  |   | Credit risk   | Market risk   | Treasury and capital risk  | Operational risk   | Reputation risk  |
|                  | <ul style="list-style-type: none"> <li>Provide climate horizon scanning information and emerging trends to BRC and Principal Risk Leads.</li> <li>Recommend risk appetite statement, constraints and exclusions to BRC.</li> <li>Define areas of concern and recommend scenario analysis priorities.</li> <li>Lead the development of climate-specific risk methodologies</li> <li>Interpret stress test results for relevance as drivers of risk</li> <li>Review and challenge risk type approaches and support consistency across risk types</li> <li>Aggregate and monitor a central climate risk view across in scope risk types</li> </ul> | <ul style="list-style-type: none"> <li>Review individual obligors' exposure using Climate Change Lens.</li> <li>Consider Climate Change risk appetite in relevant countries and portfolios.</li> <li>Include in the Internal Capital Adequacy Assessment Process (ICAAP).</li> <li>Oversight by Retail and Wholesale Risk Management Committees, and Board Risk Committee.</li> </ul> | <ul style="list-style-type: none"> <li>Identify and assess climate-related risk factors.</li> <li>Apply stress scenarios, assess stress losses and set risk limits.</li> <li>Include in ICAAP.</li> <li>Oversight by Market Risk Committee and Board Risk Committee.</li> </ul> | <ul style="list-style-type: none"> <li>Identify exposure to climate risk.</li> <li>Consider key indicators and limits to support risk management.</li> <li>Include in ICAAP and Internal Liquidity Adequacy Assessment Process (ILAAP).</li> <li>Oversight by Treasury &amp; Capital Risk Committee and Board Risk Committee.</li> </ul> | <ul style="list-style-type: none"> <li>Integrate climate change across different risk categories, e.g. Resilience and Premises.</li> <li>Include climate change within risk assessment processes including Strategic Risk Assessment.</li> </ul> | <ul style="list-style-type: none"> <li>Outline minimum requirements and controls for Reputation Risk management relating to client relationships or transactions.</li> <li>Outline the expected business behaviours in relation to these issues.</li> <li>Outline the approach to enhanced due diligence.</li> </ul> |
| Ownership        | Climate Risk Accountable Officer  | Credit Risk Accountable Officer   | Market Risk Accountable Officer   | Treasury & Capital Risk Accountable Officer  | Operational Risk Accountable Officer   | Group Head of Sustainability   |

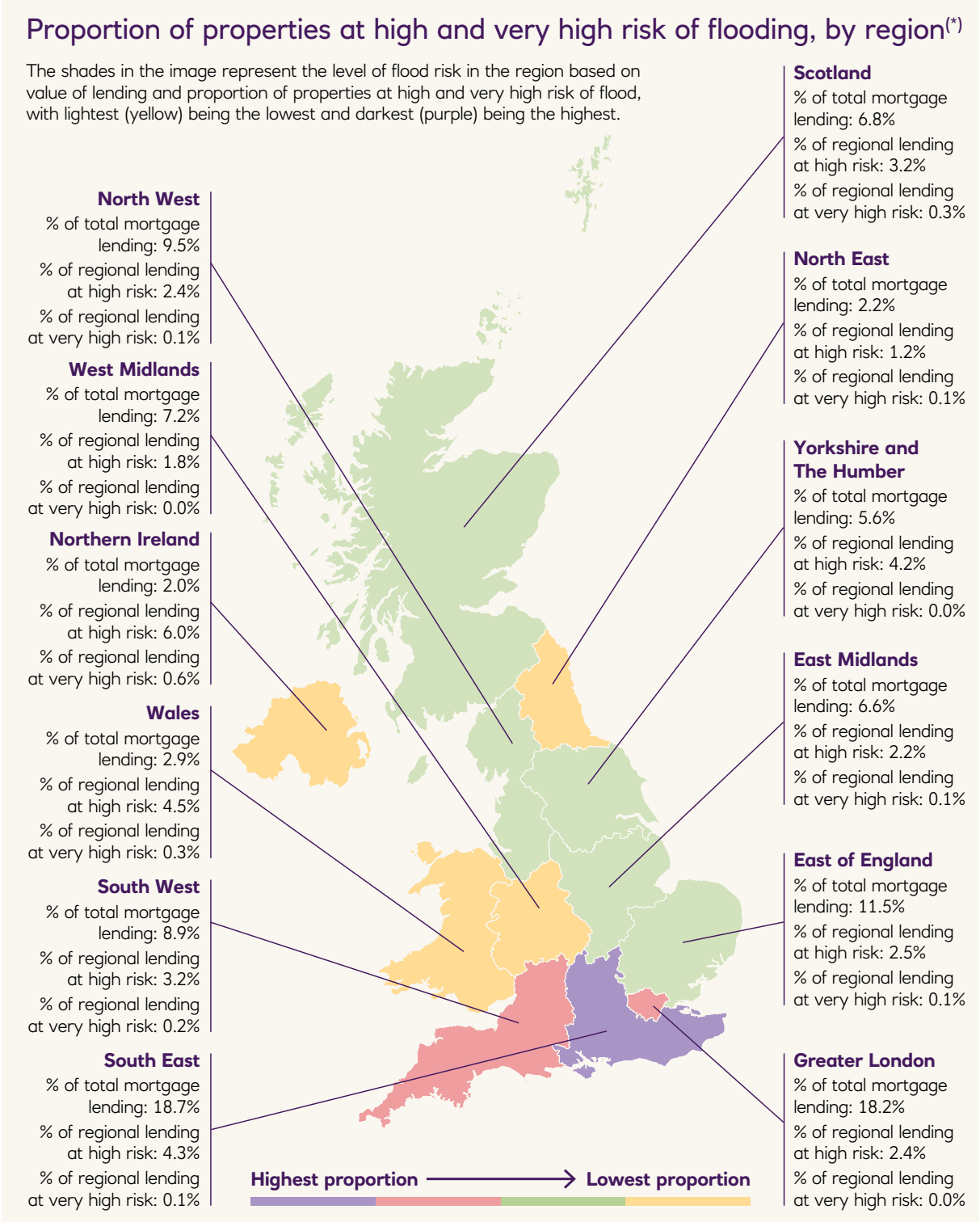
Note: BRC = Board Risk Committee.

# 3. Metrics and Targets

## 3.1 Metrics

**Figure B-27: Natwest Group PLC, 2021 Climate-related disclosures report (p. 63)**

Mapping of flood risks across the organisation’s property portfolio, showing metric: percentage of regional property portfolio at high/very high risk. The definitions of high/very high risks should be clearly given in the description.



**Figure B-28: The Goldman Sachs Group, [Accelerating transition: Task force on climate-related financial disclosures report 2021](#) (p. 31)**

Semi-quantitative risk categories, low/medium/high, can be useful as precise quantitative metrics may give a misleading picture of accuracy. This table shows how physical risk metrics for each hazard correspond to these semi-quantitative risk categories.

| PHYSICAL RISK   | RATING CATEGORY                 | INTERPRETATION   |
|---|---------------------------------|--|
| Extreme Temperature   | ↓ Low Risk                      | Zero consecutive hot (>95°F) days  |
|   | ↑↑ High Risk                    | 20 consecutive hot days or more  |
| Heat Stress   | ↓ Low Risk                      | Moderate and hard work is allowed  |
|   | ↑↑ High Risk                    | Limited moderate work, hard work is forbidden  |
|   | ↑↑↑ Extreme High Risk           | Exercise is forbidden. Very high risk for heat casualties  |
| Water Stress  | ↓ Low Risk                      | Water Stress (WS)<20%  |
|   | ↑ Medium Risk                   | 20%<=WS<75%  |
|   | ↑↑ High Risk                    | 75%<=WS<100%   |
|   | ↑↑↑ Extreme High Risk           | WS>=100% (insufficient water supply)   |
| Energy Consumption  | ↓ Low Risk                      | No increase in consumption from baseline   |
|   | ↑↑ High Risk                    | Consumption increased 20% from baseline  |
| Hurricane (Saffir-Simpson Hurricane wind scale 1-5)                   | ↓ Low Risk                      | Produce no damage  |
|   | ↑ Medium Risk (1-2)             | Extreme dangerous winds will cause extensive damage  |
|   | ↑↑ High Risk (3-4)              | Devastating damage will occur  |
|   | ↑↑↑ Extreme High Risk (5)       | Catastrophic damage will occur, a high percentage of framed homes will be destroyed, with total roof failure and wall collapse |
| Coastal Flooding Frequency & Sea Level Rise                           | ↓ Low Risk                      | 100-year flood returns once in 100 years or less   |
|   | ↑ Medium Risk                   | 100-year flood returns between 2 and 5 times in 100 years  |
|   | ↑↑ High Risk                    | 100-year flood returns more often than 5 times in 100 years  |
| Wildfire (Size Class of Fire by National Wildfire coordinating group) | ↓ Low Risk (Class A, B, C)      | Wildfire size less than 100 Acres  |
|   | ↑ Medium Risk (Class D, E)      | Wildfire size between 100 to 1000 Acres  |
|   | ↑↑ High Risk (Class F)          | Wildfire size between 1000 and 5000 Acres  |
|   | ↑↑↑ Extreme High Risk (Class G) | Wildfire size greater than 5000 Acres  |
| Seismic Risk (Ranks 1-10)   | ↓ Low Risk (1-4)                | 1 = Not felt, 2 & 3 = Weak, 4 = Light  |
|   | ↑ Medium Risk (5-6)             | 5 = Moderate, 6 = Strong   |
|   | ↑↑ High Risk (7-8)              | 7 = Very strong, 8 = Severe  |
|   | ↑↑↑ Extreme High Risk (9-10)    | 9 = Violent, 10 = Extreme  |

**Figure B-29: Nationwide Building Society, [Annual report & 2021](#) (p. 52)**

Metrics show the aggregated physical impact on a sector in a clear and transparent way, including definitions of flood zones and how they are calculated. The tables show the number of properties at risk from flooding now and in 2050 under a Representative Concentration Pathway (RCP) 4.5 scenario. It may be useful to provide a more extreme scenario as RCP 4.5 implies a rise in mean global temperature of only 1.8°C, which is not a high physical risk scenario.

**Physical risk data**

| Prime mortgages   | As at 31 Dec 20 |              |           | As at 31 Dec 19 |              |                  |
|---|-----------------|--------------|-----------|-----------------|--------------|------------------|
|   | Number          | Exposure £bn | % of Book | Number          | Exposure £bn | % of Book        |
| Properties in red flood risk zone (note i)  | 457             | 0.05         | 0         | 433             | 0.05         | 0                |
| Properties in amber flood risk zone (note i)  | 27,610          | 3.36         | 2         | 25,991          | 3.22         | 2                |
| Buy to let and legacy mortgages   | As at 31 Dec 20 |              |           | As at 31 Dec 19 |              |                  |
|   | Number          | Exposure £bn | % of Book | Number          | Exposure £bn | % of Book        |
| Properties in red flood risk zone (note i)  | 203             | 0.02         | 0         | 204             | 0.02         | 0                |
| Properties in amber flood risk zone (note i)  | 9,160           | 1.08         | 3         | 8,506           | 0.98         | 3                |
| RCP 4.5 30-year scenario – prime and buy to let and legacy (Dec 20)                                     |                 |              |           |                 |              |                  |
| Total number of properties affected by incremental future flooding (to the nearest thousand)            |                 |              |           |                 |              | 95,000           |
| Total number of properties deemed uninsurable (to the nearest hundred) / (percentage of book) (note ii) |                 |              |           |                 |              | 1,800 / (0.10%)  |
| Overall financial impact  |                 |              |           |                 |              | Low <sup>5</sup> |
| RCP 4.5 30-year scenario – registered social landlords (Dec 20)   |                 |              |           |                 |              |                  |
| Total number of RSL properties (to the nearest thousand)  |                 |              |           |                 |              | 180,000          |
| Percentage matched to JBA data  |                 |              |           |                 |              | 87%              |
| Total number of matched properties affected by future flooding (to the nearest hundred)                 |                 |              |           |                 |              | 600              |
| Overall financial impact  |                 |              |           |                 |              | Low <sup>5</sup> |

Notes: JBA = [JBA Consulting](#); RSL = Registered Social Landlords.



**Figure B-30: UBS, [Climate report 2021](#) (p. 36)**

A set of aggregate climate-related risk metrics, including “total exposure to climate-sensitive sectors, physical risk” (p. 36) can provide valuable information to investors and other stakeholders, provided the methodology, assumptions, and data sources are given.

**Climate-related metrics 2021**

|   | For the year ended |          |          | % change from |
|---|--------------------|----------|----------|---------------|
|   | 31.12.21           | 31.12.20 | 31.12.19 | 31.12.20      |
| <b>Risk management</b>  |                    |          |          |               |
| Carbon-related assets (USD billion) <sup>1,2</sup>  | 45.6               | 45.4     | 40.1     | 0.4           |
| <i>of which: UBS AG (standalone)<sup>2,3</sup></i>  | 7.0                | 7.6      | 7.5      | (8.7)         |
| <i>of which: UBS Switzerland AG (standalone)<sup>2,3</sup></i>                            | 37.9               | 37.1     | 31.9     | 2.4           |
| <i>Proportion of total customer lending exposure, gross (%)</i>                           | 9.9                | 10.4     | 10.7     |               |
| Total exposure to climate-sensitive sectors, transition risk (USD billion) <sup>2,4</sup> | 37.5               | 37.5     | 33.4     | 0.0           |
| <i>of which: UBS AG (standalone)<sup>2,3</sup></i>  | 4.6                | 5.4      | 5.8      | (15.9)        |
| <i>of which: UBS Switzerland AG (standalone)<sup>2,3</sup></i>                            | 32.8               | 31.7     | 27.3     | 3.4           |
| <i>Proportion of total customer lending exposure, gross (%)</i>                           | 8.2                | 8.6      | 9.0      |               |
| Total exposure to climate-sensitive sectors, physical risk (USD billion) <sup>2,4</sup>   | 25.5               | 26.2     | 25.6     | (2.8)         |
| <i>of which: UBS AG (standalone)<sup>2,3</sup></i>  | 10.8               | 11.5     | 13.1     | (6.1)         |
| <i>of which: UBS Switzerland AG (standalone)<sup>2,3</sup></i>                            | 13.6               | 13.5     | 11.7     | 1.4           |
| <i>Proportion of total customer lending exposure, gross (%)</i>                           | 5.6                | 6.0      | 6.9      |               |
| Identified significant climate-related financial risk on balance sheet <sup>5</sup>       | None               | None     | None     |               |

# Appendix C. Banks' and investors' physical risk disclosure survey data summary

% of 57 bank climate risk disclosure reports that included an assessment of physical risks.

|                  | Strategy |      |      |      |      |      |      |      | Risk Management |      |      |      |      | Metrics & targets |      |      |      |
|------------------|----------|------|------|------|------|------|------|------|-----------------|------|------|------|------|-------------------|------|------|------|
|                  | S.a1     | S.a2 | S.a3 | S.b1 | S.b2 | S.b3 | S.c1 | S.c2 | R.a1            | R.a2 | R.a3 | R.b1 | R.b2 | M.a1              | M.a2 | M.a3 | M.c1 |
| <b>No report</b> | 48       | 48   | 48   | 48   | 48   | 48   | 48   | 48   | 48              | 48   | 48   | 48   | 48   | 48                | 48   | 48   | 48   |
| <b>Grade 0</b>   | 18       | 28   | 32   | 27   | 39   | 45   | 18   | 36   | 7               | 25   | 41   | 35   | 34   | 34                | 41   | 47   | 50   |
| <b>Grade 1</b>   | 17       | 17   | 8    | 15   | 8    | 6    | 11   | 12   | 19              | 16   | 6    | 9    | 8    | 6                 | 6    | 0    | 1    |
| <b>Grade 2</b>   | 13       | 6    | 11   | 11   | 5    | 1    | 15   | 4    | 21              | 10   | 5    | 7    | 7    | 9                 | 3    | 5    | 1    |
| <b>Grade 3</b>   | 4        | 1    | 1    | 0    | 0    | 0    | 8    | 1    | 5               | 2    | 0    | 1    | 3    | 3                 | 3    | 1    | 0    |

% of 25 investor climate risk disclosure reports that included an assessment of physical risks.

|                  | Strategy |      |      |      |      |      |      |      | Risk Management |      |      |      |      | Metrics & targets |      |      |      |
|------------------|----------|------|------|------|------|------|------|------|-----------------|------|------|------|------|-------------------|------|------|------|
|                  | S.a1     | S.a2 | S.a3 | S.b1 | S.b2 | S.b3 | S.c1 | S.c2 | R.a1            | R.a2 | R.a3 | R.b1 | R.b2 | M.a1              | M.a2 | M.a3 | M.c1 |
| <b>No report</b> | 65       | 65   | 65   | 65   | 65   | 65   | 65   | 65   | 65              | 65   | 65   | 65   | 65   | 65                | 65   | 65   | 65   |
| <b>Grade 0</b>   | 14       | 15   | 25   | 11   | 21   | 24   | 14   | 10   | 13              | 30   | 34   | 18   | 21   | 18                | 20   | 30   | 34   |
| <b>Grade 1</b>   | 14       | 11   | 3    | 17   | 11   | 7    | 13   | 17   | 17              | 0    | 1    | 13   | 6    | 8                 | 8    | 1    | 0    |
| <b>Grade 2</b>   | 3        | 8    | 6    | 7    | 3    | 3    | 7    | 7    | 3               | 6    | 0    | 4    | 8    | 4                 | 6    | 1    | 0    |
| <b>Grade 3</b>   | 4        | 0    | 1    | 0    | 0    | 1    | 1    | 1    | 3               | 0    | 0    | 0    | 0    | 4                 | 1    | 3    | 1    |



United Nations Environment Programme Finance Initiative (UNEP FI) is a partnership between UNEP and the global financial sector to mobilise private sector finance for sustainable development. UNEP FI works with more than 450 members—banks, insurers, and investors—and over 100 supporting institutions—to help create a financial sector that serves people and planet while delivering positive impacts. We aim to inspire, inform and enable financial institutions to improve people’s quality of life without compromising that of future generations. By leveraging the UN’s role, UNEP FI accelerates sustainable finance.

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Natural resources are at the foundation of economic opportunity and human wellbeing. But today, we are depleting Earth’s resources at rates that are not sustainable, endangering economies and people’s lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

### **Our Vision**

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

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