BANK NEGARA MALAYSIA
CENTRAL BANK OF MALAYSIA

2024 Climate Risk Stress Testing Exercise

Methodology Paper

Applicable to:

1. Licensed banks, including licensed digital banks
2. Licensed investment banks
3. Licensed Islamic banks, including licensed Islamic digital banks
4. Prescribed development financial institutions
5. Licensed insurers, including professional reinsurers
6. Licensed takaful operators, including professional retakaful operators

Issued on: 29 February 2024 BNM/RH/PD 028-132

TABLE OF CONTENTS

SUMMARY OF CHANGES

Version	Date	Section/Chapter	Summary of Changes	Page (s)
1.0	Feb 2024	-	Initial version	-
2.0	June 2024	Part C1	Table 3: Summary of Assumptions for Long-term Climate Scenarios – Portfolio Coverage for Banks	22
		Part C2 Chapter 15	Paragraph 15.1	24
		Part C2	Table 4: Summary of Assumptions for 1-Year Acute Physical Risk Scenario – Portfolio Coverage for Banks	25
		Appendix 2	Appendix 2: Indicative list of sectoral breakdowns – reference paragraph to 13.20	29
3.0	March 2025	Part C1	Table 1: Long-Term Climate Scenarios – change in the reference year for mean global warming temperature from “relative to pre-industrial average in 2050” to “relative to pre-industrial average in 2100”	11
		Appendix 5	Appendix 5: List of domestic banking groups, Islamic banks and LIFBs – addition of PT. Bank Muamalat Indonesia, Tbk to Cohort 2 Banks	34

PART A OVERVIEW

1. Introduction

1.1 Climate change and its impact on the environment and economic agents may pose material risks to the safety and soundness of financial institutions, giving rise to broader implications to the economy and financial system. Recognising the risk from climate change to the financial system in Malaysia, financial institutions are required to conduct climate risk stress testing to assess potential vulnerabilities to various climate scenarios.

1.2 The 2024 Climate Risk Stress Test (CRST) exercise is primarily intended to facilitate financial institutions' learning and capacity building in addressing risks from climate change. Financial institutions must aim to gain vital hands-on experience in measuring the impact of climate-related risks on their assets, insurance/takaful liabilities and business operations through the 2024 CRST exercise. Although current risk measurement approaches may not yet be sufficiently comprehensive and accurate to produce robust estimates of climate-related risks impact, the 2024 CRST exercise will provide financial institutions an opportunity to refine their existing risk management strategy and explore new stress testing approaches that are relevant for assessing climate-related risks.

1.3 More specifically, the 2024 CRST exercise aims to enhance financial institutions' capabilities in the following areas:

(a) Improve understanding and appreciation among board, senior management, and staff of financial institutions on how the business and operations of the financial institutions could be impacted by climate-related risks;

(b) Explore novel approaches that could lead to better identification and measurement of financial institutions' exposures at risk to climate change; and

(c) Identify current gaps, specifically those related to data, measurement, methodology, technology, and capabilities, as well as potential solutions to these challenges.

In carrying out the 2024 CRST exercise, financial institutions are strongly encouraged to collaborate with one another to share experiences, build capacity, and collectively address relevant challenges, for example, sharing of climate-related data that may not be widely available. Financial institutions may leverage on existing industry platforms such as the Joint Committee on Climate Change (JC3) for this purpose.

1.4 Given the uncertainty surrounding future climate pathways and evolving approaches for identifying and measuring climate-related risks, the Bank expects the climate risk stress test to become a recurring exercise moving forward. Therefore, financial institutions are expected to continue investing in and improving on the foundations that they have built in preparation for the 2024 CRST exercise.

2. Applicability

2.1 This methodology paper is applicable to financial institutions as defined in paragraph 4.2.

3. Legal provision

3.1 This methodology paper is issued pursuant to–

(a) sections 47, 143 and 266 of the Financial Services Act 2013 (FSA);

(b) sections 57, 155 and 277 of the Islamic Financial Services Act 2013 (IFSA); and

(c) sections 41, 116 and 126 of the Development Financial Institutions Act 2002 (DFIA).

4. Interpretation

4.1 The terms and expressions used in this methodology paper shall have the same meanings assigned to them in the FSA, IFSA or DFIA, unless otherwise defined in this methodology paper.

4.2 For the purposes of this methodology paper–

"S" denotes a standard, an obligation, a requirement, specification, direction, condition and any interpretative, supplemental and transitional provisions that must be complied with. Non-compliance may result in enforcement action;

"G" denotes guidance which may consist of statements or information intended to promote common understanding and advice or recommendations that are encouraged to be adopted;

"board" refers to the board of directors of a financial institution;

"climate-related risks" refers to potential risks that may arise from climate change, their related impact and their economic and financial consequences, which include drivers of climate-related risks, namely physical, transition and insurance/takaful risks.

"financial institution"[1] refers to–

(a) a licensed bank, a licensed digital bank, a licensed investment bank, a licensed Islamic bank, a licensed Islamic digital bank, a licensed international Islamic bank, and a prescribed development financial institution (each herein referred to individually as "bank" or collectively as "banks"); and

(b) a licensed insurer, a licensed professional reinsurer, a licensed takaful operator, and a licensed professional retakaful operator (each herein referred to

[1] Notwithstanding the definition of the term "financial institution" which includes a licensed digital bank, a licensed Islamic digital bank and a licensed investment bank, the participation of licensed digital banks, a licensed Islamic digital bank, and a licensed investment banks in 2024 CRST exercise is optional.

individually as “insurer and takaful operator” or collectively as “insurers and takaful operators”); and

“senior management” refers to the chief executive officer (CEO) and senior officers of a financial institution.

4.3 The glossary set out in Appendix 3 describes selected terms used in this methodology paper.

4.4 The acronyms used in this methodology paper and their meaning are set out in Appendix 4 of this methodology paper.

5. Related legal instruments and policy documents

5.1 This methodology paper must be read together with other relevant legal instruments, policy documents, guidelines, circulars, *etc.* that have been issued by the Bank, in particular–

(a) Climate Change and Principle-based Taxonomy (CCPT) issued on 30 April 2021;

(b) Value-based Intermediation Financing and Investment Impact Assessment Framework (VBIAF) issued on 1 November 2019;

(c) Stress Testing (for insurers and takaful operators) issued on 30 June 2016;

(d) Stress Testing (for banking institutions) issued on 15 June 2017; and

(e) Climate Risk Management and Scenario Analysis (CRMSA) issued on 30 November 2022.

PART B GENERAL REQUIREMENTS

6. Participation

S 6.1 Financial institutions must ensure that the participation and coverage for the 2024 CRST exercise is as wide as possible considering the fact that all parts of the financial system could be affected by climate change in diverse and distinct ways.

S 6.2 Financial institutions are required to participate in the 2024 CRST exercise and observe the requirements set out in this methodology paper at the entity level.

G 6.3 Financial institutions may exclude the following from the 2024 CRST exercise:

(a) exposures of the financial institutions' overseas branches; and

(b) financial institutions' overseas subsidiaries.

This is in recognition that financial institutions may not have sufficient data, the relevant data for other countries' climate scenarios may not be readily available in the format required to facilitate the 2024 CRST exercise or the financial institution may not have the capability or capacity to stress test the relevant exposures at this juncture. However, financial institutions are encouraged to submit the outstanding exposures of their overseas branches and subsidiaries which are at risk to climate change to provide a better indication to the Bank on the financial institutions' overall exposures to climate-related risks.

G 6.4 For this inaugural 2024 CRST exercise, the participation of licensed digital banks, licensed Islamic digital banks, and licensed investment banks is optional. This mainly reflects the early operations of licensed digital banks in Malaysia and challenges in directly linking physical and transition risks from climate change to the underlying risk drivers for the business of investment banks[2] at this juncture.

S 6.5 In deciding whether to participate in the 2024 CRST exercise, investment banks should consider the specificities of their business mix and their vulnerability to physical and transition risks arising from climate change. For instance, some investment banks may have structured finance portfolios which could be significantly affected by climate-related risks. Licensed investment banks that are part of a domestic banking group should also consider the degree of business interlinkages they may have with other entities in the group, their ability to leverage on group-wide stress testing capabilities, and the potential benefits of deriving a broader group-wide view of the impact of climate-related risks and their portfolios.

G 6.6 The Bank will continue to monitor investment banks' assessment of climate risks via their compliance with the policy document on CRMSA and may require their involvement in future stress tests once there is a better understanding of the nature of climate-related risks faced by licensed investment banks.

[2] Investment banks' main lines of business are either very short-term and volatile in nature (such as for their share margin-financing portfolios) or are fee-based (such as merger and acquisition advisories).

7. Governance

S 7.1 In running the 2024 CRST exercise, financial institutions shall observe the governance process as stipulated in the policy documents on Stress Testing for licensed banks, licensed insurers and takaful operators, respectively.

S 7.2 This includes ensuring that the board exercises oversight on the development and implementation of the 2024 CRST exercise. Among others, the board must be responsible for ensuring that the design of the 2024 CRST exercise, including the input parameters, key assumptions and methodologies, is appropriate to the nature, scale, complexity of its risk-taking activities.

G 7.3 The board should provide constructive challenge on the results of 2024 CRST exercise, and consider insights from the exercise in informing the financial institution's risk and business strategies.

G 7.4 Prescribed development financial institutions are encouraged to observe the governance process stipulated in the policy document on Stress Testing for licensed banks for the purpose of the 2024 CRST exercise.

8. Compliance

G 8.1 The Bank does not intend to use the quantitative outcome of the 2024 CRST exercise to calibrate institution-specific capital requirements for climate-related risks.

G 8.2 However, this does not preclude the ongoing supervisory review process of ensuring that all material risks including those that are climate-related are adequately managed by financial institutions. The Bank will use insights from the 2024 CRST exercise, including the level of exposure and progress in strengthening capabilities to manage climate risk to facilitate supervisory reviews and engagements with financial institutions. Where progress by a financial institution towards strengthening its resilience to climate-related risks remains inadequate, the Bank may consider broader use of its supervisory toolkit as appropriate, including the use of capital add-ons.

PART C SCENARIOS

9. Overview

S 9.1 To achieve the intended outcomes of the 2024 CRST exercise as described in this methodology paper, financial institutions shall conduct the 2024 CRST exercise by employing the following three long-term adverse climate scenarios to capture the impact from a range of different combinations of physical and transition risks:

(a) Net Zero 2050 (NZ 2050);

(b) Divergent Net Zero 2050 (DNZ 2050); and

(c) Nationally Determined Contributions (NDCs).

G 9.2 The three climate scenarios for the 2024 CRST exercise are based on internationally recognised scenarios developed by the Network for Greening the Financial System (NGFS).

S 9.3 In addition to the scenarios prescribed in paragraph 9.1, financial institutions shall conduct a short-term acute physical risk scenario, which considers a one-off 1-in-200-years flood event in Malaysia.

PART C1 LONG-TERM CLIMATE SCENARIOS

10. Scenario specifications

S 10.1 Financial institutions must conduct the 2024 CRST exercise based on the three long-term climate scenarios as per the NGFS Phase III[3] integrated assessment model outputs that were released in September 2022.

G 10.2 These NGFS scenarios include member countries' commitments to reach net-zero emissions made at COP26,[4] and have been enriched with additional sectoral granularity (e.g., further breakdown of the transport sector to reflect modes of transportation, and increased granularity in industrial carbon dioxide (CO_2) gas emissions).

G 10.3 The selection of these climate scenarios reflects the potential different pathways on how physical risk and transition risk could evolve in Malaysia between now until 2050. For example, reaching net zero emissions as early as 2050 will require Malaysia to embark on an ambitious coordinated transition journey across all sectors of the economy. On the other hand, the impact from severe physical risk will lead to larger negative impacts on economic growth under the NDCs scenario.

An overview of each NGFS climate scenario that will be used for the 2024 CRST exercise is set out as follows:

(a) Orderly: NZ 2050

This climate scenario rests on strong climate policies and significant green technology breakthroughs to rapidly reduce greenhouse gas (GHG) emissions, limiting global warming to 1.5°C. It reflects key features of an early and orderly

[3] For the avoidance of doubt, financial institutions must use the NGFS Phase III climate scenario parameters that were released in September 2022. This considers the fact that the NGFS may release updated versions of these climate parameters in future publications.

[4] COP 26 refers to the 26th United Nations Climate Change Conference held in Glasgow, Scotland in 2021.

transition to a low carbon world. To achieve this goal, stringent climate policies are applied immediately across all sectors of the economy, while significant innovation and technology breakthrough will have to take place. This includes major strides in the carbon dioxide removal (CDR) technology and a sharp shift toward renewable energy production, resulting in high transition risk.

(b) Disorderly: DNZ 2050

This scenario differs from the NZ 2050 scenario in several aspects. Here, global climate policies are much more stringent in selected economic sectors, reflecting a quicker phase-out of fossil fuels and the impact thereof. The distributional impacts from climate policies are uneven, with some sectors being affected even more relative to the rest suggesting varied focus of climate policies being introduced at different points in time. This could result from the imposition of differentiated carbon taxes or carbon prices across certain economic sectors. Moreover, technology advancements in CDR and renewable energy are lower relative to NZ 2050 reflecting inherent limitations of adequate financial funding and constraints within existing economic structure. The combination of these factors is expected to result in a medium to higher transition risks, relative to the NZ 2050 scenario, while the impact from physical risk on the economy will be lower than the NDCs scenario.

(c) Hot House World: NDCs

The NDCs scenario assumes both implemented and pledged policy measures are fully implemented but remains inadequate to facilitate an orderly transition. While emissions decline, the limited policy actions taken are insufficient and will lead to an approximately 2.5°C increase in temperatures, and a materialisation of moderate to severe physical risks. Compared to the other two scenarios, impact from transition risks is expected to be lower for this scenario.

Limitations of NGFS Long-term Climate Scenarios for the 2024 CRST exercise

G 10.4 The entire set of NGFS climate scenarios is based on the Shared Socioeconomic Pathway 2 (SSP2), which describes a world that follows a path where social, economic, and technological trends do not deviate sharply from historical trends. These long-term climate scenarios were designed to consider global and regional conditions and were downscaled to specific countries. However, they do not comprehensively capture extreme and catastrophic climate events, nor do they sufficiently address the intricate nonlinear relationships between climate events and their economic impacts. For example, these climate scenarios do not consider tipping point events such as the collapse of the Antarctica ice sheets, which could contribute to accelerated sea-level rise, resulting in irreversible ecological damage and financial losses in certain parts of the world.

G 10.5 Similarly, these climate scenarios do not incorporate specific national policies to address climate risks. Specifically, government climate-related policies are not directly embedded in these climate scenarios, instead they are approximated through shadow carbon prices, which may not always align with local conditions. These limitations could lead to an understated assessment of the actual impact of government climate-related policies, potentially downplaying their eventual outcomes to the economy and financial system.

G 10.6 In the case of Malaysia, the Government launched the National Energy Transition Roadmap (NETR) in 2023, with the aim of providing support to the nation's aspiration to achieve net-zero emissions as early as 2050. As NETR is a country-specific climate-related policy, which is excluded from consideration in NGFS climate

scenarios, its implementation over time may lead to its impact not being fully captured under the current set of NGFS climate scenarios. Financial institutions should consider how the impact of domestic policies such as the NETR might evolve under the DNZ 2050 and NDCs scenarios and impact certain transition variables such as the shadow carbon price pathway, emissions trajectory, domestic energy prices, and energy consumption and energy mix. These qualitative considerations should be reported to the Bank in the reporting template.

G 10.7 Given the limitations and consequences described in paragraphs 10.4, 10.5 and 10.6, the Bank intends to continue exploring approaches to better reflect national-level policy developments in future iterations of the CRST exercise. In the meantime, the Bank expects financial institutions to exercise prudence when interpreting results from the 2024 CRST exercise.

G 10.8 Financial institutions are encouraged to refine, calibrate, or introduce more granular stress test parameters and assumptions to enhance the accuracy of their 2024 CRST results. They may expand on the above climate scenarios, with the intention to improve the robustness and realism of the stress test.

S 10.9 However, any new assumption or climate scenario expansion must be aligned with the long-term and short-term scenario narratives prescribed by the Bank. The additional parameters and assumptions must be clearly explained to the Bank in the reporting template.

Table 1: Additional details on the NGFS Scenarios (Phase III)

	NZ 2050	DNZ 2050	NDCs
Physical risk	Limited	Limited	High
Mean global warming relative to pre-industrial average in 2100	1.4°C	1.4°C	2.6°C
Malaysia's surface temperature based on IPCC's AR6 95th Percentile (in 2050)	26.9 °C	26.9 °C	27.8 °C
Transition risk	High	Moderate to higher	Lower
Estimated average shadow carbon price in Malaysia (in 2050, USD per tCO_2e based on 2010 prices, and regional carbon prices)	USD 325.40	USD 698.90	USD 41.60

Source: Intergovernmental Panel on Climate Change, NGFS and Bank Negara Malaysia

Scenario variables

G 10.10 The Bank provides selected climate and macroeconomic variables for all prescribed climate scenarios. These climate variables, embodying physical risk and transition risk, are based on the high-level global and regional pathways as simulated by the NGFS and have been downscaled and calibrated to Malaysia[5] via the National Institute Global Econometric Model. Consequently, the impact from these climate variables under the above scenarios on the rest of the economy are reflected in the macroeconomic and financial market data provided by the Bank.

G 10.11 To elaborate further, the physical risk and transition risk variables for Malaysia are mapped to key aggregate macroeconomic and financial variables, as seen in Table 2. These variables would simulate the combined impact from the physical risk and transition risk associated with each scenario. No additional shocks beyond the climate-related ones have been incorporated into the macroeconomic model simulation. The evolution of macroeconomic and financial variables following the climate-related shocks also consider fiscal and monetary policy reactions. For fiscal policy, this would include assumptions on how revenue from carbon tax is earmarked for public investment or recycled as households tax reliefs. Regarding monetary policy, these assumptions pertain to reactions concerning risks to inflation and gross domestic product (GDP) growth.

G 10.12 The variables supplied under the various scenarios are meant to serve as a starting point for financial institutions' modelling and assessments. Notwithstanding this, financial institutions are encouraged to perform further scenario expansion,[6] as stated in paragraph 10.8, to enhance the accuracy of their assessments. For example, financial institutions with large exposures to the agricultural sector could consider expanding the scenario paths to more granular geographical locations in Malaysia. Financial institutions may leverage the variables provided by the NGFS, JC3's Climate Data Catalogue or other data sources for this purpose.[7]

S 10.13 Financial institutions must ensure that any additional assumptions or climate scenario expansions taken as prescribed in paragraph 10.12, are aligned with the long-term and short-term scenarios prescribed by the Bank. The additional parameters and assumptions must be clearly explained by the financial institution to the Bank in the reporting template.

G 10.14 For the avoidance of doubt, the supplied macroeconomic, financial, and climate-related data in this document are for the purpose of the 2024 CRST exercise and should not be taken as an assessment of the efficacy of domestic climate policy to address future risks from climate change nor should they be construed as actual forecasts of the future.

[5] Refers to NGFS Phase 3 Scenario Explorer and NGFS Climate Impact Explorer by Climate Analytics.
[6] Scenario expansion in this context refers to the process of extrapolating or calibrating additional scenario variables from the set of variables provided by the Bank.
[7] For an indicative list of potential data sources, refers to Appendix 4 of the 2024 Climate Risk Stress Testing Exercise Discussion Paper, published on 30 June 2022.

Table 2: Scenario Variables[8]

Climate Variables	Macroeconomic Variables	Financial Market Variables
Physical variables • Near-surface temperature Transition variables • Shadow carbon price pathway • Emissions pathway • Global and domestic energy prices • Energy consumption and energy mix	• GDP • Gross value added (GVA) by selected sectors • Private/government consumption • Private/government investment • Exports and imports (goods and services) • Headline Inflation • Unemployment rate • House price index (residential, 2015=100)	• Central Bank policy interest rate (%) • 3-year, 5-year, 10-year and 15-year Malaysian Government Securities yield • 3-year, 5-year, 10-year and 15-year private debt security yield (by rating) • Real effective exchange rate (index; 2017=100) • Exchange rate (domestic per USD) • Equity prices (index; 2017=100)

11. Time horizon

G 11.1 In coming up with a suitable time horizon, the Bank considered that some aspects of physical risk such as rising average temperature and sea level would only materialise over the long-term.

S 11.2 To ensure that the 2024 CRST exercise can adequately capture these risks, financial institutions must consider the time horizon for the long-term climate scenarios that will span over a 27-year period from December 2023 (as the starting position) until 2050. Financial institution shall report to the Bank the projected impact of the CRST on an annual basis from 2024 until 2029, followed by a 5-year interval throughout the rest of the stress horizon. Financial institutions are required to submit to the Bank the following:

(a) The first projection reporting point is on 31 December 2024;

(b) An annual recurring projection report at the end-of calendar years 2025, 2026, 2027, 2028 and 2029; and

(c) Subsequent projection reporting at the end of calendar years 2030, 2035, 2040, 2045 and 2050, respectively.

For the avoidance of doubt, financial institutions must submit the projection reports to the Bank by the deadlines stipulated in paragraph 18.1.

[8] All variables are for Malaysia only unless otherwise indicated.

G 11.3 The more frequent reporting intervals for the first six years reflects that many macroeconomic variables (e.g., real GDP and headline inflation) tend to exhibit greater volatility in the initial years of the climate scenarios. This arises following the initial transition shocks due to the imposition of climate-related policies, and the ensuing adjustments that one might expect from it. For instance, under the DNZ 2050 scenario, the implementation of an energy tax (e.g., carbon tax), which tends to be relatively higher compared to the NZ 2050 scenario, raises energy costs in the short-term, impacting the final demand for consumer goods and services. The increase in energy costs, however, also contributes to higher general price levels resulting in an uptick in headline inflation. These effects are expected to be transitory and will moderate over time as the economy adjusts to these new conditions.

12. Balance sheet assumptions

S 12.1 Financial institutions shall adopt a static balance sheet assumption for their quantitative assessments. This means that financial institutions must not factor in planned management actions such as strategic portfolio changes as part of the climate scenario to ease the challenge of projecting the composition of the balance sheet over the long assessment horizon (up to 2050).

G 12.2 This approach considers that many financial institutions still face considerable challenge in forecasting their strategies and modelling the climate impact over a long horizon.

S 12.3 Financial institutions shall conduct the quantitative assessment by assuming the starting balance sheet for each year of the stress test horizon is identical to the balance sheet as of end-2023. This enables financial institutions to focus on assessing the outcomes of their current risk management approach and business strategy as climate risks materialise.

S 12.4 For each reporting year (referred to in paragraph 11.2 for the reporting periods), financial institutions shall incorporate the impact of climate-related risks between the base starting position of 2023 and the specific reporting year.

G 12.5 To illustrate, consider a hypothetical scenario involving a bank's projections for impairments based on shocks from the climate scenarios. In 2024, the bank projects an increase in impairments compared to its baseline in 2023, but no further increase in impairments for the rest of the CRST horizon, 2025 to 2050. The bank would therefore only report an increase in expected credit losses (ECL) in the 2024 reporting year. The losses incurred in 2024 should not be added to subsequent years' reporting. Thus, there would be no increase in ECL for reporting year 2025 to 2050. In this case, the impairments at the end of each reporting year during the period 2025 to 2050 are assumed to be the same as those in 2023.

G 12.6 Consider another hypothetical scenario involving insurers and takaful operators' (ITOs) assessing their equity investment portfolios. If there is a decline in equity market's performance in 2024, all mark-to-market valuation losses will be reported for the 2024 reporting year. Assuming a relative stable equity market for the remainder of the CRST horizon, 2025 to 2050, ITOs will consistently report "nil" for mark-to-market valuation changes, as the fair value for their equity investment portfolios remains unchanged from the recorded value in 2023.

S 12.7 For simplicity, financial institutions are to assume that the remaining maturity of their assets remains constant throughout the CRST horizon.

G For example, a 30-year mortgage or bond with a remaining maturity of 20 years at the end of 2023 (i.e., the starting position of the 2024 CRST exercise), will be treated as a mortgage or bond with a remaining maturity of 20 years throughout the CRST horizon.

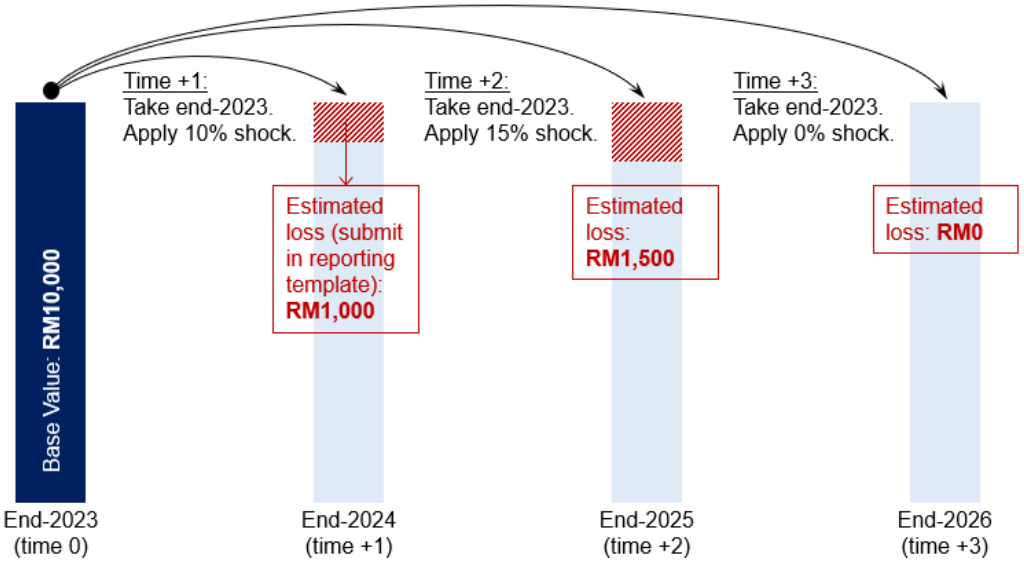
G 12.8 As the 2024 CRST exercise is intended to facilitate capacity building, financial institutions are still encouraged to reflect upon possible management actions in response to the impact of the prevailing climate scenario on its static balance sheet. This may be documented qualitatively in the reporting template rather than in the quantitative assessment.

S 12.9 Financial institutions shall record key details of the assessment methodologies and assumptions in the reporting template provided to facilitate the interpretation of the results of the 2024 CRST exercise by the Bank.

Diagram 1: Illustration of Assessment using the Static Balance Sheet Assumption

Assumptions:

- A financial institution starts with an exposure of RM10,000 at the end of 2023, which could represent a loan exposure for banks or an invested assets/liability exposure for ITOs.
- Shock parameters for time +1, time +2, and time +3 are 10%, 15%, and 0%, respectively. These shocks encompass factors such as increased probability of default, decline in equity market performance, or increased insurance claims (whichever is applicable to the financial institution).
- Estimated losses are calculated based on the exposure as of end-2023 for each reporting period (time +1, time +2, and time +3). These estimated losses could represent ECL, mark-to-market losses from invested assets, or insurance payouts for medical/fire claims.



13. Assessing climate-related risks to financial institutions' exposures

S 13.1 The Bank acknowledges the current limitations in data and modelling capabilities constraining a comprehensive quantitative assessment of the impact of various climate scenarios on all financial risk exposures. Therefore, only selected risks will be required to be assessed quantitatively for the 2024 CRST exercise.

S 13.2 Financial institutions shall assess the impact of the climate scenarios on significant financial risk exposures. The assessment approach, quantitative or qualitative, will be differentiated by the materiality of the risk, depending on the type of financial institution:

(a) Banks shall adopt a quantitative approach when assessing the credit risk portfolio. They may adopt a qualitative approach when assessing the market risk, liquidity risk and operational risk portfolios; and

(b) ITOs shall adopt a quantitative approach when assessing the market risk as well as insurance and takaful risk. They may adopt a qualitative approach when assessing credit risk, liquidity risk and operational risk.

G 13.3 In relation to insurance and takaful risk, the Bank acknowledges the significance of liability risk that may arise from environmental or climate-related litigations. However, such scope of liability risk is excluded from consideration in this inaugural 2024 CRST exercise to reduce modelling complexities.

G 13.4 The qualitative impact assessment approach for the selected risk types specified above acknowledges the current limitations in data and modelling capabilities, while still providing financial institutions with an opportunity to enhance their understanding of the various risk transmission channels and the overall impact from climate-related risks. The quantification of these risks will be considered in future CRST iterations.

G 13.5 Financial institutions are encouraged to broaden their range of quantitatively assessed risks beyond the minimum list stated in paragraph 13.2, subject to their own individual capabilities for doing so.

S 13.6 In assessing the impact from the climate scenarios, financial institutions are reminded to be conservative and mindful of the expectations provided in paragraph 10.7. For example, financial institutions shall not assume growth in the value of collateral, or improvement in borrowers' debt servicing capacity following improvements in corporates' profitability or household income, which effectively reduces the risks in financial institutions' exposures.

S 13.7 In the same vein, given the limitations of the NGFS climate scenarios mentioned in paragraphs 10.4, 10.5, and 10.6 and in the absence of new climate shocks modelled over the long-run, financial institutions could see their CRST results moderating over the long-term across all climate scenarios. This may lead to an underestimation of losses arising from climate-related events. In tandem with paragraph 10.7, financial institutions shall exercise caution and care when interpreting their 2024 CRST results, particularly when considering appropriate management action to reduce financial institutions' vulnerabilities to climate risks.

G 13.8 Financial institutions should seek to leverage their assessment and classification of economic activities as provided for in the CCPT in relevant areas for the CRST exercise. This is to ensure CRST input assumptions and results are consistent with the financial institutions' ongoing efforts to appropriately categorise risk exposures based on the extent to which they meet climate objectives and promote transition to a

low-carbon economy. For instance, counterparty-level due diligence assessments conducted for CCPT purposes could serve as valuable inputs for the 2024 CRST exercise. Financial institutions should also assess if the classification and reporting of exposures under the CCPT are consistent with the areas and magnitude of risks derived from the results of their 2024 CRST exercise.

S 13.9 Financial institutions shall also ensure that the CRST models used to size up the climate-impact on the balance sheet are sufficiently granular to meaningfully differentiate between the drivers of losses across the various climate scenarios.

G 13.10 Where there is a reliance on third party service providers to assist financial institutions to carry out this inaugural 2024 CRST exercise, financial institutions should have relevant processes in place to ensure that financial institutions understand how the data and models are being developed. This is intended to ensure that the data and models used are appropriate to capture the climate-related risks to the financial institutions and to maximise learning opportunities.

Banks

Quantitative Assessment of Credit Risk

S 13.11 Given that credit risk exposures make up a significant portion of banks' balance sheet, banks shall quantitatively assess how climate-related risk could lead to changes in their borrowers' repayment ability, collateral value, or loan recovery in the event of default, thus increasing the expected credit losses.

S 13.12 At minimum, banks shall measure the credit risk of both their on- and off-balance sheet exposures in the following segments:

(a) all business lending (including lending to large corporates and small and medium enterprises), comprising of loans, sukuk and bonds; and

(b) selected household lending comprising of loans to purchase residential properties, loans to purchase non-residential properties and hire purchase loan/financing.

Banks shall document any deviation from the above minimum requirements in the reporting template.

S 13.13 For other segments not specified in paragraph 13.12, such as underwriting activities or counterparty risk from derivatives transactions, banks shall apply proportionality in deciding whether to quantitatively assess the associated credit risk. In this regard, banks shall prioritise exposures that are more material and vulnerable to climate-related risks. Banks shall document these additional segments in the reporting template.

G 13.14 The Bank is cognisant that there are various approaches to measure climate-related credit risks of businesses and households. However, to ensure a more consistent level of quality and comparability across different banks, the Bank has specified some minimum expectations for this assessment. These are detailed in the subsequent paragraphs.

G 13.15 Banks may recognise insurance policies or takaful certificates, such as fire insurance policies, that are already in place to offset the estimated losses from credit risk. However, they should not assume additional insurance coverage beyond that which was already in force as of 31 December 2023. Banks should document the assumptions underpinning their treatment of insurance and takaful coverage in the reporting template.

Businesses Credit Risk – Sectoral Level Assessment

G 13.16 Climate-related risks have the potential to affect businesses through transition risk (e.g., increase in operating costs due to carbon pricing) and physical risk (e.g., severe disruption to operations due to damage to premises and equipment from flooding or damage to crops due to drought). Businesses across the different economic sectors may be affected differently by these risks and as such, banks are expected to carry out the credit risk assessment on businesses at the sectoral level, as well as at the counterparty level for selected sectors.

S 13.17 In this regard, banks shall assess the creditworthiness of their business borrowers, considering the potential default risk arising from changes in financial conditions because of climate change, such as variations in cash flow, increased operational costs, or reductions in asset values. Banks shall also take into consideration the potential deterioration of recoverable collateral value in its credit risk assessment. For instance, the collateral value of real estate and commodities may be heavily affected by physical risk induced by climate change.

S 13.18 Climate-related risks are typically sectoral specific and highly localised by geography. Therefore, in quantifying the impact of climate-related risks, banks shall consider the relevant sectoral- as well as geographical-specific attributes of the businesses in their portfolio that may have a bearing on credit risk. For example, a business' main sources of revenue, operations and collateral values may be impacted differently depending on the location of its operations and assets. The climate impact across the sectors and geographical location should be reasonably differentiated in line with the scenarios provided. While the Bank does not provide any climate or macroeconomic variables for jurisdictions outside Malaysia, banks may utilise data available in the NGFS portal or other data sources to model the climate-impact for businesses with operations or assets outside Malaysia.

S 13.19 There are various approaches to modelling the impact of climate-related risks on banks' business portfolio. For instance, banks may (i) model the climate-related impact for each individual business in their portfolio and sum the impact; (ii) model the climate-related impact on a sample of businesses and extrapolate the magnitude of impact for the rest of the sector; or (iii) use existing credit risk models and apply a climate-related risk factor to differentiate the climate-related impact across sectors and scenarios. Should banks decide to leverage existing Basel or MFRS 9 credit risk models by imputing the climate-adjusted macroeconomic variables provided by the Bank, they must assess if these models are sufficiently robust to capture climate-related risks, particularly across the longer time horizons of the 2024 CRST exercise.

Businesses Credit Risk – Counterparty Level Assessment

S 13.20 Banks shall conduct a counterparty-level analysis which involves deeper scrutiny of the cashflows and earnings of individual businesses operating in selected economic sectors that are deemed more vulnerable to physical risk and transition risk. Banks may refer to Appendix 2 for a detailed breakdown of the selected economic sectors.

S 13.21 Banks should not take into consideration the counterparties' climate mitigation and adaptation plans in their assessment, unless these plans are already announced, underway and are judged to be highly likely to be completed. In this regard, banks are expected to leverage on their CCPT classifications for each counterparty to inform an exposure's degree of transition to sustainable practices.

G 13.22 Banks are encouraged to use their counterparty's actual data (e.g., emission data, climate-related strategies, and location) where available.

S 13.23 Where assumptions and proxy data are being used in place of banks' counterparty's actual data, banks must be able to identify how the methodology and data sources could influence the results of the 2024 CRST.

S 13.24 For this inaugural 2024 CRST exercise, banks shall assess at least the top 10 individual business counterparties (entity level) by exposure size in each of the economic sectors listed in Appendix 2. These sectors were identified based on their sensitivity to transition risk and physical risk. For counterparties with diversified business lines that are not listed in Appendix 2, banks shall classify these counterparties based on their main economic activity or sector of their parent group.

Household Credit Risk

G 13.25 Households are also increasingly vulnerable to climate change, affecting both their probability of default (e.g., loss of income) and loss given default (e.g., decline in the value of their collateral pledged) due to the materialisation of transition risk and physical risk.

S 13.26 For specific household lending portfolios, additional climate-related drivers may also amplify the impact of climate change on these portfolios. As such, banks shall consider the following drivers:

(a) Purchase of residential properties and non-residential properties

- Increased transition risk due to low energy efficiency of properties, leading to property price discounts and higher cost on their properties to retrofit to greener standards; and
- Increased physical risk as severe physical climate perils can cause significant damage to properties in a particular location and lead to property price discounts and lack of insurability.

(b) Purchase of passenger cars

- Increased transition risk due to the implementation of carbon tax (congestion tax or other traffic limitation regulations) on vehicles to reduce GHG emissions or higher adoption of electric vehicles impacting the demand for internal combustion engine vehicles; and
- Increased physical risk due to damages to vehicles from nature-related events like floods.

G 13.27 Banks may use their existing stress test models by imputing climate-adjusted macroeconomic variables to size up the impact of credit losses from its household portfolio.

S 13.28 If banks decide to use their existing stress test models, they should assess whether there are any enhancements to the models necessary to capture climate-related drivers for credit losses, since existing models may not have been designed for CRST purposes. This may entail for example, applying an adjustment scalar/factor multiplier over the model-derived expected losses for certain segments of the household sector that the banks have identified to be more vulnerable to climate change.

Insurers and Takaful Operators (ITOs)

Quantitative Assessment of Market Risk

G 13.29 The unpredictable nature of severe weather events and natural disasters, coupled with uncertainties in timing and intensity, can amplify the volatility in financial markets. Additionally, changes in policies, shifts in investor sentiment, and technological advances may lead to business disruptions and sudden change in prices for financial assets. ITOs are particularly susceptible to market risk due to their significant holdings of invested assets. This risk is not limited to life and family ITOs; but also affects general ITOs' financial assets, notably through collective investment schemes (CIS) and direct investment in bonds.

S 13.30 ITOs shall conduct quantitative assessments to understand how climate-induced changes in financial markets could impact the valuation and performance of their investments.

G 13.31 ITOs may consider the following aspects when measuring the impact from climate-related risks on their investment portfolios:

(a) Potential changes in the ratings and valuations of assets, influenced by changes in the landscape of the economic sector or the profiles of financial asset issuers. This includes factors such as shifts in consumer preferences, stranded assets, and the imposition of new climate-related policies; and

(b) Examination of correlations between assets affected by climate-related risks, leading to potential breakdowns that could diminish the effectiveness of hedges and challenge prevailing risk management assumptions.

G 13.32 As the development of climate-related risk modelling and methodologies for assessing long-term market risk is ongoing, ITOs have the flexibility to leverage on their existing models (with additional considerations detailed in the preceding paragraph) or apply new methodologies.

S 13.33 When submitting results, ITOs must also report a brief description of their approach.

S 13.34 ITOs shall report their assessments by the type of assets in the reporting template. For instance, ITOs must evaluate the impact of climate-induced changes on selected financial market instruments, such as Government bonds, corporate bonds, equities, and CIS. For corporate bonds, ITOs shall assess the impact by rating categories.

Quantitative Assessment of Insurance and Takaful Risk

G 13.35 The unique nature of insurance and takaful risk, which can be independent from macroeconomic and financial market developments, underscores their distinct importance to ITOs' business activities. It is crucial to note that insurance and takaful risk is another primary risk for ITOs. This highlights the need for ITOs to quantify and understand the potential losses from payouts for claims under the long-term climate scenarios. For this inaugural 2024 CRST, the assessment on insurance and takaful risk will focus on the impact from climate change in Malaysia.

S 13.36 The assessment shall be conducted at the insurance funds or takaful sub-funds level (for life and family ITOs) and respective lines of business (for general ITOs) and reported in accordance with the reporting template.

G 13.37 ITOs can consider the following examples (these are illustrative and not the minimum standard; ITOs are encouraged to employ best, and reasonable efforts based on their available resources and capabilities):

(a) Life and family ITOs can formulate assumptions around mortality shocks and changes to payouts for medical claims resulting from physical risk events within specific scenarios. ITOs may explore methods such as studying the correlation between near-surface air temperature, heat waves, and mortality rates or collaborating with consultants or experts to devise appropriate methodologies; and

(b) General ITOs can approximate property price shocks in specific geographical locations based on changes in property price indices, supplemented with historical flood occurrence data. This could be used to estimate losses from higher claims arising from physical risk events under the long-term scenarios.

S 13.38 In estimating losses, ITOs shall assume that claims are payable within the specific reporting year and calculate losses for both gross and net of reinsurance or retakaful recoverable. When estimating recoverable from reinsurance or retakaful arrangements, where appropriate, ITOs should adjust the amounts recoverable in consideration of losses due to potential defaults of reinsurers or retakaful operators, taking into account their financial ratings and reinstatement premiums or contributions.

S 13.39 Specifically, ITOs only need to report the estimated impact of the assessment and the broad assumptions used, if any, in the reporting template. While the Bank does not require the details of projection and assessment methodologies, ITOs should document these internally, as the Bank may engage selected ITOs when reviewing the results. Please refer to the reporting template for the detailed submission scope and granularity.

Qualitative Assessment of Market Risk (banks only), Credit Risk (ITOs only), Liquidity Risk and Operational Risk (all financial institutions)

S 13.40 Please refer to the reporting template for the list of guiding questions for these risks. Financial institutions shall also submit their qualitative assessment of these risks if an assessment has been conducted.

Table 3: Summary of Assumptions for Long-term Climate Scenarios

	Banks	ITOs
Balance Sheet Starting Position	31 December 2023	
Exercise Horizon	End-2023 until end-2050	
Portfolio Coverage	**Required** Businesses: All business lending (including lending to large corporates and small and medium enterprises), comprising of loans, sukuk and bonds, at sectoral and counterparty levels. Households: Selected household lending comprising of loans to purchase residential properties, loans to purchase non-residential properties and hire purchase loan/financing.	**Required** Respective life insurance funds, family takaful sub-funds and general ITOs' lines of business
Scenario Parameters	**NZ 2050:** SSP2, Year 2050 **DNZ 2050:** SSP2, Year 2050 **NDCs:** SSP2, Year 2050	
Insurance / Takaful Coverage	Insurance/takaful coverage may be considered based on coverage already in force as of 31 December 2023 to offset the estimated lose from credit risk.	Not applicable
Reinsurance	Not applicable	Assume claims are payable within the reporting year, accounting for both gross and net of reinsurance/retakaful Make appropriate adjustments for losses from potential defaults of re-ITOs, considering their credit ratings, and reinstatement premiums/contributions

PART C2 SHORT-TERM ACUTE PHYSICAL RISK SCENARIO

14. Scenario specifications

S 14.1 The short-term acute physical risk scenario considers a one-off 1-in-200 years flood event, occurring nationwide in Malaysia consistent with climate conditions in the Intergovernmental Panel on Climate Change (IPCC)'s Representative Concentration Pathway (RCP) 8.5 scenario in the year 2050.

(a) This scenario specification is deemed suitable for stress testing, taking into consideration that the 1-in-200 years flood event is significantly more severe than past flood events in Malaysia. Furthermore, the RCP 8.5 scenario considers a future where no global policy change is adopted, leading to a climate pathway with the highest increase in physical risks compared to other RCPs.

(b) Additionally, the above specification, which seeks to bring forward the expected impact of future climate conditions from the year 2050, is particularly important when establishing the severity of the one-off flood event given that climate change is expected to exacerbate the impact of future floods.

S 14.2 Financial institutions shall quantitatively assess the direct impact of the short-term acute physical risk scenario on their portfolio based on the scenario specification given by the Bank.

G 14.3 Financial institutions are encouraged but not required to incorporate possible indirect impacts of the flood event into their assessments. Examples of these indirect impacts include possible spillovers to overall macroeconomic conditions and supply chain disruptions.

G 14.4 Given the capacity-building goal of this inaugural 2024 CRST exercise, financial institutions should explore the use of flood risk-specific models that are able to establish a clearer and more direct link between flood damage in a given location and their portfolio exposures. In contrast, the use of traditional stress test models that correlate losses with macroeconomic variables may not be sufficiently sensitive to capture the actual losses financial institutions may face in the event of a flood. Such events may produce severe yet highly localised damages that may not necessarily translate to commensurate movements in macroeconomic variables.

S 14.5 Financial institutions must assume no policy interventions from the Government which may reduce losses estimated for the 2024 CRST exercise.

S 14.6 Historically, the east coast of peninsular Malaysia has been more susceptible to riverine floods (i.e., fluvial floods) while major urban areas have experienced more frequent flash floods (i.e., pluvial floods). Financial institutions shall consider the impact from both types of flooding. In determining the areas affected by the nationwide flood, financial institutions must include key economic areas such as Selangor, Penang, Johor, Wilayah Persekutuan Kuala Lumpur, and other areas where the financial institutions have large exposures to such that their cumulative exposures account for more than 75% of their portfolio.

S 14.7 At a minimum, financial institutions must conduct their assessment of flood risk at the postcode level. As a clarification of this requirement, financial institutions must be able to meaningfully differentiate the severity of estimated hazard impacts by postcode. For example, assigning the same hazard impact to all postcodes within Kuala Lumpur would not meet the expectations set out for the 2024 CRST exercise.

G 14.8 Financial institutions may opt for a more granular spatial resolution (e.g., based on longitudes/latitudes or other coordinate systems) for their assessment of flood risk. However, in instances where the resolution of a given portfolio is only available at the postcode level whereas the hazard impacts are available at a more granular resolution, care must be taken to ensure that risks are appropriately captured. For example, assigning the same set of granular coordinates to all loans with the same postcode may unintentionally lead to financial institutions greatly underestimating losses if the said coordinates happen to be in a low-risk area. Similarly, losses may be greatly overestimated should coordinates happen to be grouped into a high-risk area.

Time horizon

S 14.9 Financial institutions shall assume that the one-off flood event occurs on 1 January 2024. This assumption seeks to simplify and standardise how financial institutions assess the risk event by eliminating the need to consider other flood events and their timings throughout the year.

S 14.10 Financial institutions shall apply the shocks from the flood event to their balance sheet position as of 31 December 2023.

15. Exercise parameters for banks

S 15.1 At minimum, banks shall quantitatively assess the impact of the flood event on all loans for the purchase of residential and non-residential properties, and construction loans for the business segment.

S 15.2 For other segments that are not referred in paragraph 15.1, banks shall apply proportionality in determining whether such segments warrant inclusion in their flood risk assessment. In this regard, banks shall prioritise the inclusion of exposures that are material and vulnerable to flood risk. These additional segments shall be documented accordingly in the reporting template.

G 15.3 Banks are particularly encouraged to assess loans for the purchase of motor vehicles and other types of loans collateralised by properties that are not already covered in the 2024 CRST exercise. Banks which are unable to assess these loans at the current juncture should build their capacity to do so, as future iterations of the CRST may require an assessment of these exposures.

S 15.4 In assessing its loan portfolio under the short-term acute physical risk event, banks must also adopt the balance sheet treatment specified under the long-term climate scenarios, as detailed in Part C1.

S 15.5 Banks must assess the direct impact of the flood event. This includes how the flood event will decrease collateral values and affect the repayment capacity of flood-affected borrowers.

S 15.6 Banks may recognise flood insurance policies or takaful certificates that may offset projected losses. However, they should not assume additional insurance coverage beyond that which was already in force as of 31 December 2023. Banks shall document the assumptions underpinning their treatment of insurance and takaful coverage in the reporting template.

S 15.7 Where possible, banks shall assess their loans based on the location of loan utilisation. This is to ensure that the location of the physical collateral corresponds with the location of estimated flood hazards. In instances where information on the location of loan utilisation is not available, banks may opt to proxy this via the use of the borrower's address. Banks shall report what share of their portfolios have their locations proxied by the borrower's address.

16. Exercise parameters for ITOs

S 16.1 ITOs must quantitatively assess the impact of the flood event on all flood risk coverage for properties and motor vehicles within insurance policies and takaful certificates.

G 16.2 ITOs are encouraged but not required to assess impact on insurance policies and takaful certificates for contractors' all risks and engineering segments.

S 16.3 In assessing their insurance and takaful portfolios under the short-term physical risk event, ITOs shall adopt the balance sheet treatment specified under the long-term climate scenarios, as detailed in Part C1.

S 16.4 ITOs must adopt the approach specified in paragraph 13.38 when accounting for the impact of reinsurance and retakaful recoverables.

Table 4: Summary of Assumptions for 1-Year Acute Physical Risk Scenario

	Banks	ITOs
Balance Sheet Starting Position	31 December 2023	
Exercise Horizon	1 year	
Portfolio Coverage	**Required** Loans for the purchase of residential and non-residential properties Construction loans **Encouraged** Loans for the purchase of motor vehicles, other types of loans that are collateralised by properties	**Required** Property- and motor vehicle-related flood insurance policies/takaful certificates **Encouraged** Contractors' all risk and engineering insurance policies/takaful certificates
Flood Parameters	**Pathway:** RCP 8.5, Year 2050 **Return Period:** 1-in-200 years flood **Date of flood:** 1st January 2024	
Insurance/ Takaful Coverage	Insurance/takaful coverage may be considered for assessed loans, based on coverage already in force as of 31 December 2023	Not applicable
Minimum Assessment Granularity	Postcode-level	

PART D CONDUCT OF THE 2024 CRST EXERCISE

17. Information to be reported to the Bank

S 17.1 The 2024 CRST reporting template consists of two sections:

(a) Section 1 consists of quantitative data templates which must be used by the financial institutions to report to the Bank key metrics for the long-term climate scenarios and the 1-year acute physical risk scenario; and

(b) Section 2 contains qualitative questionnaires which financial institutions must complete and submit to the Bank.

S 17.2 In addition to the quantitative and qualitative assessments, financial institutions are required to submit to the Bank a detailed report on:

(a) The methods to validate the suitability of models and datasets used in the 2024 CRST exercise, particularly those provided by a third-party service provider;

(b) The approach to identify the location of the borrowers and collateral to facilitate physical risk assessment; and

(c) Financial institutions' learning points and challenges in running the 2024 CRST exercise. This is expected to inform, among others, future work priorities for both the financial industry and the Bank.

18. Submission deadline

S 18.1 Financial institutions are required to submit the results of the 2024 CRST exercise, in particular, data templates, supporting documents, and responses to the qualitative questions in accordance with the submission deadlines for each respective cohort of financial institutions as detailed in Table 5. The list of financial institutions and their respective cohorts can be found in Appendix 5 and Appendix 6 respectively.

Table 5: Submission by Cohorts

	Cohort 1	Cohort 2
Financial institutions	Domestic banking groups, selected locally incorporated foreign banks (LIFBs) & ITOs	Other banks, development financial institutions (DFIs) & ITOs
Submission deadline	By 30 June 2025	By 31 December 2025

G 18.2 The submission deadline for each cohort takes into consideration the financial institution's size, potential portfolio exposure to climate-related risks and their internal state of readiness. This approach is also intended to facilitate industry sharing, where financial institutions can learn and improve on the experience of peers. Depending on their current state of readiness, financial institutions may request to be upgraded to an earlier cohort, for example, from Cohort 2 to Cohort 1 at the start of the 2024 CRST exercise.

APPENDICES

Appendix 1 References for modelling approaches

The Bank has compiled a list of papers on modelling approaches, which financial institutions may find useful to construct their own models. This list shall not be treated as exhaustive and does not signal the Bank's preference for a particular modelling approach.

Paper	Source
Managing Flood Risks: Leveraging Finance for Business Resilience in Malaysia	World Bank (2023)
Overview of Environmental Risk Analysis by Financial Institutions	NGFS (2020)
Case Studies of Environmental Risk Analysis Methodologies *See 'Part I ERA for Banks' and 'Part II ERA for Institutional Investors and Insurers'*	NGFS (2020)
Climate-Related Scenarios for Financial Stability Assessment: An Application to France	Bank of France (2020)
Getting Started on Physical Climate Risk Analysis in Finance – Available Approaches and The Way Forward	Institute for Climate Economics (2018)
Climate Stress Testing	Federal Reserve Bank of New York, Staff Report (2023)
Navigating a New Climate: Assessing Credit Risk and Opportunity in a Changing Climate	UNEP-FI (2018)
Integrating Climate Risks into Credit Risk Assessment	Monnin (2018)
A Framework for Assessing Financial Impacts of Physical Climate Change: A Practitioner's Aide for the General Insurance Sector	Bank of England, Prudential Regulation Authority (2019)
Methodological Principles of Insurance Stress Testing – Climate Change Component	EIOPA (2022)
Methodological Principles of Insurance Stress Testing	EIOPA (2020)
Climate Financial Risk Forum *Various guides and resources. 'Scenario Analysis – Data and tools providers spreadsheet', in particular, contains a list of 3rd party vendors for climate models/frameworks*	CFRF

[General/Overall] Climate Risk Stress Testing: A Conceptual Review	Rotterdam School of Management, Erasmus University (2023)
[General/Overall] Climate-related Financial Stability Risks for the United States: Methods and Applications	Federal Reserve Board (2022)
[For flood risk] Bank Stress Testing of Physical Risks under Climate Change Macro Scenarios: Typhoon Risks to the Philippines	IMF (2022)
[For flood risk] Flood risk and financial stability: Evidence from a stress test for the Netherlands	De Nederlandsche Bank (2021)

Appendix 2 Indicative list of sectoral breakdowns[9]

As detailed in paragraph 13.20, banks shall assess at least the top 10 individual business counterparties (entity level) by exposure size in each of the economic sectors and subsectors listed below. For example, banks must assess the top 10 individual business counterparties in the manufacturing of food and beverages sector defined as businesses classified with the Malaysia Standard Industrial Classification 2008 (MSIC 2008) with codes 11xxx and 10xxx.

Different economic sectors may be affected by climate-related risks to varying degrees. The following sectors or subsectors have been identified based on a best-efforts estimate of their vulnerability to climate-related risks and the size of the exposure to the financial system. Should a bank find that they do not have enough counterparties for the listed subsectors under the Manufacturing sector, they are encouraged to expand the assessment to include other subsectors of Manufacturing that are not listed below, based on their own assessment of materiality to climate change risks. The same expectation applies for the Agriculture, Forestry and Fishing sector and Transportation sectors for which specific subsectors were identified.

Sector (MSIC code)	Number of Counterparties
A. Agriculture, Forestry and Fishing • Oil palm (01261 and 01262)	10
B. Mining and quarrying	10
C. Manufacturing	
Food and beverages • Manufacture of beverages (11xxx) • Manufacture of food products (10xxx)	10
Vehicles • Manufacture of motor vehicles, trailers and semi-trailers (29xxx) • Manufacture of other transport equipment (30xxx)	10
Building materials, rubber and plastic products • Manufacture of basic metals (24xxx) • Manufacture of fabricated metal products, except machinery and equipment (25xxx) • Manufacture of rubber and plastics products 22xxx)	10
D. Electricity, Gas, Steam and Air Conditioning Supply	10
E. Water supply; sewerage, waste management and remediation activities	10
F. Construction	10
H. Transportation and Storage	
Land transport and transport via pipelines (49xxx)	10
Water transport (50xxx)	10
Air transport (51xxx)	10
L. Real Estate	10

[9] The indicative list of sectoral breakdowns was identified based on their vulnerability to transition and physical risks. Financial institutions to take note that this is a first attempt by the Bank to conduct such a mapping exercise and further refinements are to be expected, going forward. As such, future iterations of the CRST may include different mapping methodologies from what is published in the 2024 CRST Methodology Paper.

Appendix 3 Glossary

Carbon dioxide removal (CDR)	Anthropogenic activities removing CO_2 from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical sinks and direct air capture and storage, but excludes natural CO_2 uptake not directly caused by human activities.
Climate adaptation	Refers to the process or actions taken to lower the negative effects and/or moderate harm caused by climate change.
Climate mitigation	Refers to the process of reducing or preventing emission of GHG into the atmosphere.
Climate-related risks	The potential risks that may arise from climate change, their related impacts and their economic and financial consequences. Drivers of climate-related risks, namely physical, transition and liability risks.
Climate resilience	Iterative processes for managing change within complex systems in order to reduce disruptions and enhance opportunities associated with climate change.
Counterparty	A counterparty is the other party participating in a transaction, which could be a legal entity, unincorporated entity or collection of entities to which an exposure of financial risk may exist.
Credit risk	Credit risk (including counterparty credit risk) is the risk of a counterparty failing to perform its obligations.
Greenhouse gas (GHG) Emissions	Refers to gases that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself and by clouds. This property causes the greenhouse effect. Water vapour (H2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary GHGs in the Earth's atmosphere. Moreover, there are a number of entirely human-made GHGs in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Besides CO_2, N_2O and CH_4, the Kyoto Protocol deals with the GHGs sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). GHG emissions are separated into three scopes as follows: • Scope 1 covers direct emissions from owned or controlled sources; • Scope 2 covers indirect emissions from purchased electricity consumed by the reporting entity; and • Scope 3 covers indirect emissions from assets not owned or activities not controlled by the reporting entity along its value chain (upstream and downstream).
Insurance and takaful risk	Risk that an ITO underestimates its insurance/takaful liabilities given the uncertainty associated with the forecasted impact of climate

	change on the business written, leading to insufficient reserves held to cover those liabilities.
Liability risk	Risks stemming from parties that are seeking compensation for losses these parties may have suffered from the physical or transition risks from climate change. The climate-related litigations can directly and indirectly impact financial losses of financial institutions.
Liquidity risk	Ability of the financial institution to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses, including both market and funding liquidity. The risk that an ITO is unable to realise its investments and other assets in a timely manner to meet its financial obligations, including collateral needs, as they fall due.
Market risk	Market risk is defined as the risk of losses in on and off-balance sheet positions arising from movements in market prices.
Nationally Determined Contributions (NDCs)	A term used under the United Nations Framework Convention on Climate Change (UNFCCC) whereby a country that has joined the Paris Agreement outlines its plans for reducing its GHG emissions. In some countries the NDC would also address how the countries will adapt to climate change impacts and what support they need from, or will provide to, other countries to adopt low-carbon pathways and to build climate resilience.
Operational risk	Operational risk refers to the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events. Operational risk may result in direct financial losses as well as indirect financial losses (e.g., loss of business and market share) due to reputational damage.
Paris Agreement	An international agreement signed in 2015 to keep the average global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C.
Pathways	The temporal evolution of natural and/or human systems towards a future state. Pathway concepts range from sets of quantitative and qualitative scenarios or narratives of potential futures to solution oriented decision-making processes to achieve desirable societal goals. Pathway approaches typically focus on biophysical, techno-economic and/or socio-behavioural trajectories and involve various dynamics, goals and actors across different scales.
Physical risks	Economic costs and financial losses resulting from the increasing severity and frequency of • extreme climate change-related weather events (or extreme weather events) such as heatwaves, landslides, floods, wildfires and storms (i.e. acute physical risks); • longer-term gradual shifts of the climate such as changes in precipitation, extreme weather variability, ocean acidification and rising sea levels and average temperatures (i.e. chronic physical risks or chronic risks); and

	• indirect effects of climate change such as loss of ecosystem services (e.g. desertification, water shortage, degradation of soil quality or marine ecology). Physical risk drivers are the changes in weather and climate mentioned above that lead to physical risks and impacts on economies and financial institutions.
Scenario	A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change) and relationships. Note that scenarios are neither predictions nor forecasts but are used to provide a view of the implications of developments and actions.
Transition risks	The risks related to the process of adjustment towards a low-carbon economy. These drivers represent climate-related changes that could generate, increase or reduce transition risks. They include changes in public sector (generally government) policies, legislation and regulation, changes in technology and changes in market and customer sentiment, each of which has the potential to generate, accelerate, slow or disrupt the transition towards a low-carbon economy.
Transmission channels	The causal chains that explain how climate-related risk drivers give rise to financial risks that impact financial institutions directly or indirectly through their counterparties, the assets they hold and the economy in which they operate.

Source: Adapted from IPCC, IEA, NGFS, BCBS

Appendix 4 Acronyms

BCBS	Basel Committee on Banking Supervision
CCPT	Climate Change and Principle-based Taxonomy
CDR	Carbon dioxide removal
CIS	Collective Investment Schemes
CRMSA	Climate Risk Management and Scenario Analysis
CRST	Climate risk stress testing
DFIs	Development Financial Institutions
DFIA	Development Financial Institutions Act 2002
DNZ 2050	Divergent Net Zero 2050
ESG	Environmental, social and governance
FSA	Financial Services Act 2013
GDP	Gross domestic product
GHG	Greenhouse gas
GVA	Gross value added
IEA	International Energy Agency
IFSA	Islamic Financial Services Act 2013
IPCC	Intergovernmental Panel on Climate Change
ITOs	Insurers and takaful operators
JC3	Joint Committee on Climate Change
LIFBs	Locally incorporated foreign banks
NDCs	Nationally Determined Contributions
NETR	New Energy Transition Roadmap
NGFS	Network for Greening the Financial System
NZ 2050	Net Zero 2050
SSP	Shared Socioeconomic Pathways
VBIAF	Value-based Intermediation Financing and Investment Impact Assessment Framework

Appendix 5 List of domestic banking groups, Islamic banks and LIFBs

Cohort 1: Large FIs and selected LIFBs	Cohort 2: Other financial institutions
1. AmBank Group 2. CIMB Group 3. Hong Leong Bank Group 4. HSBC Amanah Malaysia Berhad 5. HSBC Bank Malaysia Berhad 6. Malayan Banking Berhad Group 7. OCBC Al-Amin Bank Berhad 8. OCBC Bank (Malaysia) Berhad 9. Public Bank Berhad Group 10. RHB Bank Berhad Group 11. Standard Chartered Bank Malaysia Berhad 12. United Overseas Bank (Malaysia) Berhad	1. Affin Bank Berhad Group 2. Agrobank 3. Al Rajhi Banking & Investment Corporation (Malaysia) Berhad 4. Alliance Bank Malaysia Berhad 5. Bangkok Bank Berhad 6. Bank Islam Malaysia Berhad 7. Bank Kerjasama Rakyat Malaysia Berhad (Bank Rakyat) 8. Bank Muamalat Malaysia Berhad 9. Bank of America Malaysia Berhad 10. Bank of China (Malaysia) Berhad 11. Bank Pembangunan Malaysia Berhad 12. Bank Simpanan Nasional 13. BNP Paribas Malaysia Berhad 14. China Construction Bank (Malaysia) Berhad 15. Citibank Berhad 16. Deutsche Bank (Malaysia) Berhad 17. Export-Import Bank of Malaysia Berhad (EXIM Bank) 18. India International Bank (Malaysia) Berhad 19. Industrial and Commercial Bank of China (Malaysia) Berhad 20. J.P. Morgan Chase Bank Berhad 21. Kuwait Finance House (Malaysia) Berhad 22. MBSB Bank Berhad 23. Mizuho Bank (Malaysia) Berhad 24. MUFG Bank (Malaysia) Berhad 25. Small Medium Enterprise Development Bank Malaysia Berhad (SME Bank) 26. Sumitomo Mitsui Banking Corporation Malaysia Berhad 27. The Bank of Nova Scotia Berhad 28. PT. Bank Muamalat Indonesia, Tbk

Appendix 6 List of Insurers and Takaful Operators

Cohort 1 ITOs	Cohort 2 ITOs
1. AIA Berhad 2. Allianz General Insurance Company Berhad 3. Etiqa General Insurance Berhad 4. Etiqa General Takaful Berhad 5. Generali Insurance Malaysia Berhad 6. Great Eastern Life Assurance (Malaysia) Berhad 7. Hannover Rueck SE 8. Liberty General Insurance Berhad 9. Lonpac Insurance Berhad 10. Malaysian Reinsurance Berhad 11. MSIG Insurance (Malaysia) Berhad 12. Prudential Assurance Malaysia Berhad 13. Zurich General Insurance Malaysia Berhad 14. Zurich General Takaful Berhad	1. AIA General Berhad 2. AIA Public Takaful Berhad 3. AIG Malaysia Insurance Berhad 4. Allianz Life Insurance Malaysia Berhad 5. AmMetLife Insurance Berhad 6. AmMetLife Takaful Berhad 7. Berjaya Sompo Insurance Berhad 8. Chubb Insurance Malaysia Berhad 9. Etiqa Family Takaful Berhad 10. Etiqa Life Insurance Berhad 11. FWD Insurance Berhad 12. FWD Takaful Berhad 13. Generali Life Insurance Malaysia Berhad 14. Great Eastern General Insurance (Malaysia) Berhad 15. Great Eastern Takaful Berhad 16. Hong Leong Assurance Berhad 17. Hong Leong MSIG Takaful 18. Malaysian Life Reinsurance Group Berhad 19. Manulife Insurance Berhad 20. MCIS Insurance Berhad 21. Munich Retakaful 22. Pacific & Orient Insurance Co. Berhad 23. Pacific Insurance Berhad 24. Progressive Insurance Berhad 25. Prudential BSN Takaful Berhad 26. QBE Insurance (Malaysia) Berhad 27. RHB Insurance Berhad 28. Sun Life Malaysa Takaful Berhad 29. Sun Life Malaysia Assurance Berhad 30. Swiss Re Asia Pte. Ltd./Swiss ReTakaful 31. Syarikat Takaful Malaysia Am Berhad 32. Syarikat Takaful Malaysia Berhad 33. Takaful Ikhlas Family Berhad 34. Takaful Ikhlas General Berhad 35. Toa Reinsurance Company Ltd. 36. Tokio Marine Insurance (Malaysia) Berhad 37. Tokio Marine Life Insurance Malaysia Berhad 38. Tune Insurance Malaysia Berhad 39. Zurich Life Insurance Malaysia Berhad 40. Zurich Takaful Malaysia Berhad