



BANK NEGARA MALAYSIA
CENTRAL BANK OF MALAYSIA

2024 Climate Risk Stress Testing Exercise

Discussion Paper

Applicable to:

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

This discussion paper sets out Bank Negara Malaysia's ("the Bank") proposed framework and elements of the industry-wide climate risk stress testing (CRST) exercise in 2024. The proposals include the applicability and format of the exercise, and technical elements such as scenarios selection, portfolio scope and granularity, and other considerations.

The Bank would like to invite all relevant parties, including financial institutions, non-financial corporates, industry associations, climate experts, government agencies, regulators and any other relevant organisations or individuals, to peruse this document and provide written feedback on the proposals.

Submission of feedback for the discussion paper:

- a) The Bank highly encourages the responses to be supported by appropriate rationale and evidence.
- b) All respondents are to specify the applicable paragraphs and provide sufficient examples or illustrations. In this regard, respondents are required to provide feedback through the Microsoft Excel template provided (refer to Attachment 1), particularly the tab "General Feedback".
- c) Additionally, financial institutions in particular, are invited to respond to the specific questions set out throughout the discussion paper (refer to Appendix 3 for a full list of questions and corresponding tabs in Attachment 1) and a survey on climate risk stress testing capabilities and practices.
- d) All feedback for the discussion paper and/or responses to the survey are to be submitted electronically in the prescribed format and emailed to climatechange@bnm.gov.my latest by 30 September 2022. The email must be titled "2024 CRST Discussion Paper – Feedback by [*name of institution*]".
- e) When preparing the feedback, specific queries can be directed to the following officers:
 - i. Razeen Mohd Rom (Ms): razeen@bnm.gov.my
 - ii. Muhamad Shukri Abdul Rani (Mr): shukri@bnm.gov.my
 - iii. Lim Sheng Ling (Ms): sheng@bnm.gov.my
 - iv. Muhammad Syamil Kamaruzzaman (Mr): msyamil@bnm.gov.my

TABLE OF CONTENTS

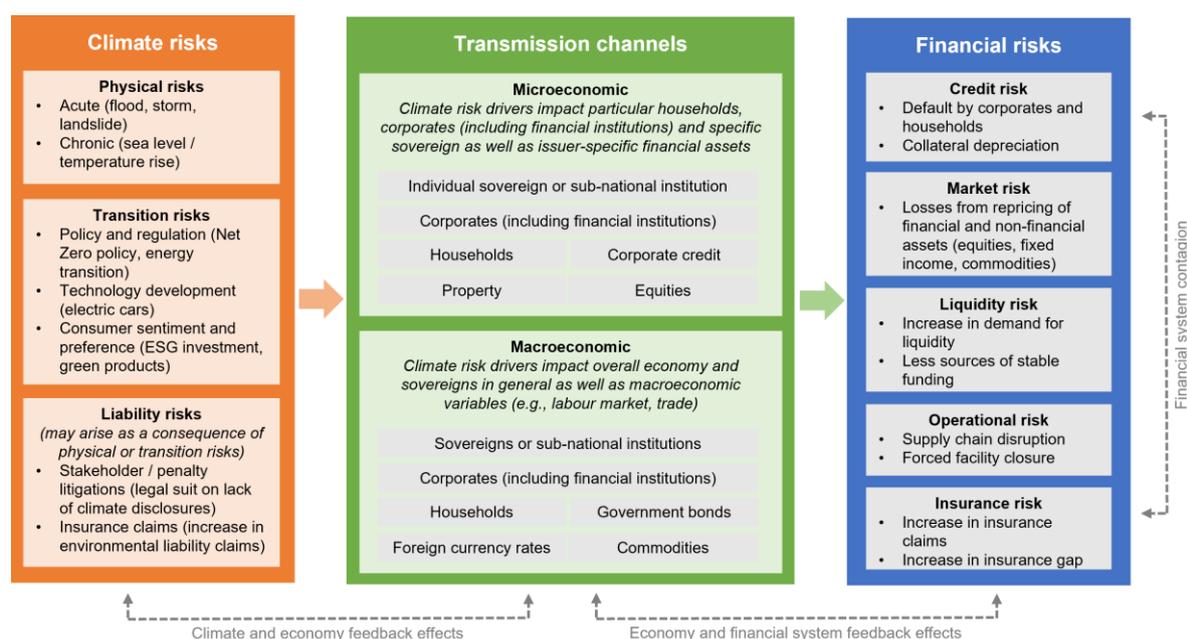
PART A	OVERVIEW.....	4
1	Introduction	4
2	Objectives of the exercise	6
3	Structure of the discussion paper	7
PART B	PROPOSED DESIGN FEATURES.....	7
4	Participation and level of applicability	7
5	Scenario narratives and time horizon	8
6	Financial risk coverage	13
7	Portfolio exposure scope and granularity	15
8	Balance sheet approach	18
PART C	CONDUCT/FORMAT OF THE EXERCISE.....	20
9	Submission requirements.....	20
10	Governance	21
11	Next steps and timeline.....	21
PART D	APPENDICES.....	24
Appendix 1	Principles for climate risk management and scenario analysis	24
Appendix 2	References for modelling approaches.....	26
Appendix 3	Full list of discussion questions	27
Appendix 4	Indicative list of potential data sources	30
Appendix 5	Indicative list of sectoral breakdown.....	32
PART E	GLOSSARY	33
PART F	ACRONYMS	36
PART G	REFERENCES	37

PART A OVERVIEW

1 Introduction

- 1.1 Climate change is a complex collective action problem that may pose material risks to the safety and soundness of financial institutions, potentially giving rise to broader implications to financial stability and sustainable economic growth. Financial institutions are thus expected to have an effective risk management framework that integrates all material risks, which extends to climate-related risks and its interactions with other risk types (Figure 1).

Figure 1: Transmission of Climate-related Risks to Financial Risks



Source: Adapted from Network for Greening the Financial System (NGFS) and Basel Committee on Banking Supervision (BCBS)

- 1.2 However, measuring climate-related risks and how these risks manifest through financial risks can be complex given several distinctive features. Most notably, such risks are typically non-linear, evolve over a longer time horizon and are global and far-reaching in nature. To meaningfully understand and measure these risks, new and unconventional approaches and tools are therefore required. With added uncertainty surrounding future climate pathways, which will be heavily dependent on global actions taken from now, it is also important to explore the effects of multiple plausible pathways. Given this, the Bank will conduct an industry-wide CRST exercise in 2024,¹ allowing industry the time in 2022 and 2023 to put in place the necessary building blocks such as investing in the necessary data infrastructure, and developing the modelling and resource capacity required to assess climate-related risks.
- 1.3 The CRST exercise builds on existing initiatives that the Bank has already embarked upon to support the industry in managing climate-related risks:

¹ Refer to paragraph 11.3 for more information on the Bank's plan and next steps.

- (a) In particular, the Climate Risk Management and Scenario Analysis (CRMSA) exposure draft² issued on 27 December 2021 contains principle-based expectations (refer to Appendix 1) on scenario analysis and guidance surrounding specific stress testing elements, as well as the necessary pre-requisites as outlined under the principle-based expectations for risk management. Building upon these principles, the CRST exercise prescribes specific stress parameters in greater detail to facilitate results comparability and industry-wide aggregation across banks, and insurers and takaful operators (ITOs);³
 - (b) Counterparty-level assessment under the Climate Change and Principle-based Taxonomy (CCPT)⁴ will facilitate credit risk assessments for the purpose of the CRST at the required level of granularity, as proposed later in this paper; and
 - (c) The Value-based Intermediation Financing and Investment Impact Assessment Framework (VBIAF),⁵ as well as the VBIAF Sectoral Guides⁶ provide guidance on risks and their transmission channels related to climate change and greenhouse gas (GHG) emissions which will be useful for financial institutions when considering these risks for the purpose of the CRST exercise.
- 1.4 The CRST framework and elements draw upon lessons from industry engagements, both domestically and through the Bank's participation in international and multilateral organisations such as the NGFS, the International Association of Insurance Supervisors (IAIS), the Sustainable Insurance Forum (SIF), the Executives' Meeting of East Asia Pacific Central Banks (EMEAP) and the World Bank. As part of the work under the Joint Committee on Climate Change (JC3), the Bank and Securities Commission Malaysia have also advanced an initiative to meet climate-related data needs by establishing a Sub-committee on Bridging Data Gaps in 2021.
 - 1.5 This discussion paper will be used as a basis for consultation and/or collaboration with relevant stakeholders on the design and specifications of the 2024 CRST exercise and other relevant complementary initiatives. This would not only involve financial institutions, but also stakeholders outside of the financial industry, such as climate scientists and subject matter experts in government ministries and agencies, and non-governmental organisations (NGOs).
 - 1.6 Based on responses to this discussion paper, the Bank will publish the final methodology and requirements pursuant to sections 47, 143 and 266 of the Financial Services Act (FSA) 2013, sections 57, 155 and 277 of the Islamic Financial Services Act (IFSA) 2013 and sections 41, 116 and 126 of the Development Financial Institutions Act (DFIA) 2002.
 - 1.7 The terms and expressions used in this discussion paper shall have the same meanings assigned to them in the FSA, IFSA or DFIA, as the case may be, unless otherwise defined in this discussion paper. Unless the context requires otherwise, the meaning of the terms used in this discussion paper is as set out in Part E (Glossary).

² See Exposure Draft on [CRMSA](#).

³ Throughout this discussion paper, the term "banks" will be used to refer to licensed banks, licensed investment banks, licensed Islamic banks, and prescribed development financial institutions, while "ITOs" will be used to refer to insurers, professional reinsurers, takaful operators and professional retakaful operators.

⁴ Refer to [CCPT](#).

⁵ Refer to [VBIAF](#).

⁶ Refer to [VBIAF Sectoral Guides](#).

2 Objectives of the exercise

- 2.1 The 2024 CRST exercise will assess the resilience of Malaysian financial institutions to physical and transition risks arising from various climate scenarios.
- 2.2 In particular, the exercise is intended to achieve the following outcomes for the financial sector:
 - (a) Quantify financial institutions' exposures to climate change and their potential losses arising from physical and transition risks;
 - (b) Facilitate financial institutions' capacity building in modelling and measuring climate-related risks, as part of their overall climate risk management tools;
 - (c) Provide useful insights to financial institutions for the purpose of strengthening current stress testing practices to incorporate climate-related risks;
 - (d) Initiate discussions among board and senior management of financial institutions on strategic and long-term plans to manage these risks;
 - (e) Identify possible responses that financial institutions may adopt to manage climate-related risks and the potential systemic risks that may arise from these actions, including possible spillovers to the economy;
 - (f) Identify current gaps and challenges faced by financial institutions to inform future collective action plans; and
 - (g) Accelerate financial institutions' data collection and quality to manage climate-related risks.
- 2.3 At this point, the Bank does not intend for the quantitative outcome of the 2024 CRST exercise to be used to directly calibrate institution-specific capital requirements. However, this does not preclude the ongoing supervisory review process of ensuring that all material risks are adequately managed by financial institutions. The Bank will use insights from the exercise, including the level of exposures and preparedness of individual financial institutions, to facilitate supervisory reviews and engagements. Where progress by a financial institution towards strengthening its resilience to climate-related financial risks remains inadequate, the Bank may consider broader use of its supervisory toolkit as appropriate, including the use of capital add-ons.
- 2.4 The Bank also intends for the exercise to be a joint learning experience. Expertise in modelling these risks is still evolving, hence this exercise aims to facilitate the development of technical capabilities within the Bank and the industry. Financial institutions thus play an essential role in ensuring this exercise achieves its intended outcomes. As a starting point, refer to Appendix 2 for a list of available modelling approaches for reference and Section 11 for more details on the industry's next steps.
- 2.5 Given its primary role to assess financial resilience, the scenario parameters and results of the CRST exercise should not be taken as an assessment of the efficacy of domestic policy measures to combat climate change. For instance, the shadow carbon price paths included in the scenarios are meant to be illustrative only, given its intended use to stress test financial institutions, and should therefore not be treated as forecasts of future prices. Future policy actions for Malaysia to address climate change will most likely extend beyond carbon pricing mechanisms (e.g., emission caps and investments in technology) and include actions that are beyond the Bank's mandates.

3 Structure of the discussion paper

- 3.1 This discussion paper sets out the Bank's current thinking regarding the 2024 CRST exercise as follows:
- (a) Part B outlines the key features of the exercise, including participation, scenario narratives and specifications, modelling horizon, and assumptions for balance sheet growth;
 - (b) Part C provides a high-level overview of the timeline of the exercise, including the critical milestones and submission requirements for participating financial institutions; and
 - (c) Part D comprises appendices to provide supplementary information.
- 3.2 To generate feedback on different elements of the exercise, specific questions are posed throughout the discussion paper.⁷ The Bank also welcomes feedback beyond these questions, particularly on:
- (a) The feasibility of financial institutions running the exercise as proposed, including areas that may require additional guidance; and
 - (b) Whether the proposed design features and conduct of the exercise would be sufficient to achieve the intended outcomes outlined in paragraph 2.
- 3.3 Financial institutions are also invited to complete the survey on climate risk stress testing capabilities and practices to help the Bank gauge current capabilities among financial institutions, as well as plans for further strengthening of such capabilities. Insights from the survey are intended to help the Bank understand potential gaps in climate-relevant capabilities, data and common limitations faced by financial institutions, and existing industry best practices, all of which will inform the final calibration of the 2024 CRST exercise.

PART B PROPOSED DESIGN FEATURES

4 Participation and level of applicability

- 4.1 The participation and coverage for the 2024 CRST exercise should be as wide as possible. This considers the fact that all parts of the financial system could be affected by climate change in diverse, novel, and distinct ways.
- 4.2 The Bank proposes for the following financial institutions to participate in the 2024 CRST exercise:
- (a) Licensed banks, licensed investment banks and licensed insurers, including licensed professional reinsurers under the FSA 2013;
 - (b) Licensed Islamic banks and licensed takaful operators, including licensed professional retakaful operators under the IFSA 2013; and
 - (c) Prescribed development financial institutions under the DFIA 2002.
- 4.3 Financial institutions are to complete the 2024 CRST exercise at the entity level, which refers to the global operations of a financial institution, including its overseas branch operations. The Bank acknowledges the importance for financial institutions to build capabilities in conducting a consolidated level exercise, which would include all financial and non-financial subsidiaries. However, given the additional complexity of such an exercise, plans to undertake group-wide consolidated level assessments will be pursued at a later stage.

⁷ Refer to Appendix 3 for the full list of questions posed in the discussion paper.

Questions on participation and level of applicability *(please elaborate where relevant):*

1. Are there any other factors that the Bank should consider when setting the scope of participation and level of applicability of the 2024 CRST exercise?
2. What kind of challenges would your institution face in order to conduct the analysis on overseas operations' exposures?

5 Scenario narratives and time horizon

Climate-related risks coverage

- 5.1 In Malaysia, physical and transition risk events have already materialised like in many other parts of the world. For example, mean temperatures, precipitation and sea levels have risen over the past several decades, with observed adverse effects on agriculture, biodiversity, water resources and public health. In December 2021, parts of Malaysia were hit with a 1-in-100 year flood event that brought upon higher-than-expected economic and financial losses. Environmental and climate experts have linked this event to extreme weather patterns caused by climate change. Ceteris paribus, such events are expected to occur more frequently in the future, potentially with greater intensity. From a transition risk perspective, businesses and financial institutions are also faced with challenges amid the transition to a low carbon economy, both globally and locally. Considering the above, the Bank proposes for the 2024 CRST exercise to encompass both physical (chronic and acute) and transition risks.
- 5.2 Given the changing preference of customers and investors towards green products and processes along economic value chains and services, the Bank acknowledges the significance of liability risk that may arise from environmental- or climate-related litigations. Nevertheless, to avoid modelling complications to the inaugural CRST exercise in 2024, the Bank proposes to exclude liability risk at this stage.

Scenario narrative and specifications

- 5.3 For the 2024 CRST exercise, the Bank intends to use three adverse climate scenarios to capture the impact from a range of different combinations of transition and physical risks. Based on internationally recognised scenarios developed by the NGFS,⁸ these climate scenarios will assume a variety of potential pathways for the evolution of the relevant fiscal and regulatory policies, and physical climate environments up to 2050 (see Box 1).
- 5.4 Specifically, the Bank proposes to use the following scenarios from the NGFS's Hot House World and Disorderly categories:
 - (a) Current Policies scenario**

Under the Current Policies scenario, governments do not impose additional measures to address climate change beyond those already implemented. Households and businesses do not change their behaviour to reduce emissions and there is limited availability of carbon dioxide removal (CDR) technologies. This causes an unconstrained increase in emissions, leading to a sharp rise in global temperature (+3°C) and a materialisation of severe physical risks in the form of increased frequency and severity of extreme weather events. Transition risks are limited, but physical risks are significant.

⁸ The Bank plans to use the latest NGFS scenarios and narratives should there be updates in time before the 2024 CRST exercise.

(b) Nationally Determined Contributions (NDCs) scenario

The NDCs scenario assumes both implemented and pledged policy measures to be effective even if they are yet to be implemented. While emissions decline, the limited policy actions taken are insufficient and will lead to an about 2.5°C increase in temperatures, and a materialisation of moderate to severe physical risks. Similar to the Current Policies scenario, transition risks are limited.

(c) Delayed Transition scenario

The Delayed Transition scenario captures the transition risks that arise from a late implementation of measures to fight climate change. As the name suggests, efforts to decrease emissions are delayed until 2030, at which point more stringent measures are suddenly introduced to compensate for the delay. Households and businesses are forced to drastically change their behaviour in response to the sudden introduction of policies, resulting in sharp macroeconomic and financial disruptions, particularly in carbon-intensive sectors affected by carbon pricing measures. Global temperature increases are limited to below 2°C, but this comes at the cost of significant disruption to the economy. Physical risks are present, although transition risks are much more severe.

- 5.5 The Bank acknowledges that Orderly scenarios⁹ may be useful as a counterfactual reference to better appreciate the severity of losses arising from the adverse climate scenarios. However, in striking a careful balance between enabling a richer assessment of climate-related risks while ensuring the information and resource needs for the inaugural CRST exercise remains tractable, the Bank proposes to narrow the climate scenarios to those that reflect severe physical and/or transition risks.

Box 1: Overview of NGFS Climate Scenarios for Central Banks and Supervisors (as at June 2021)

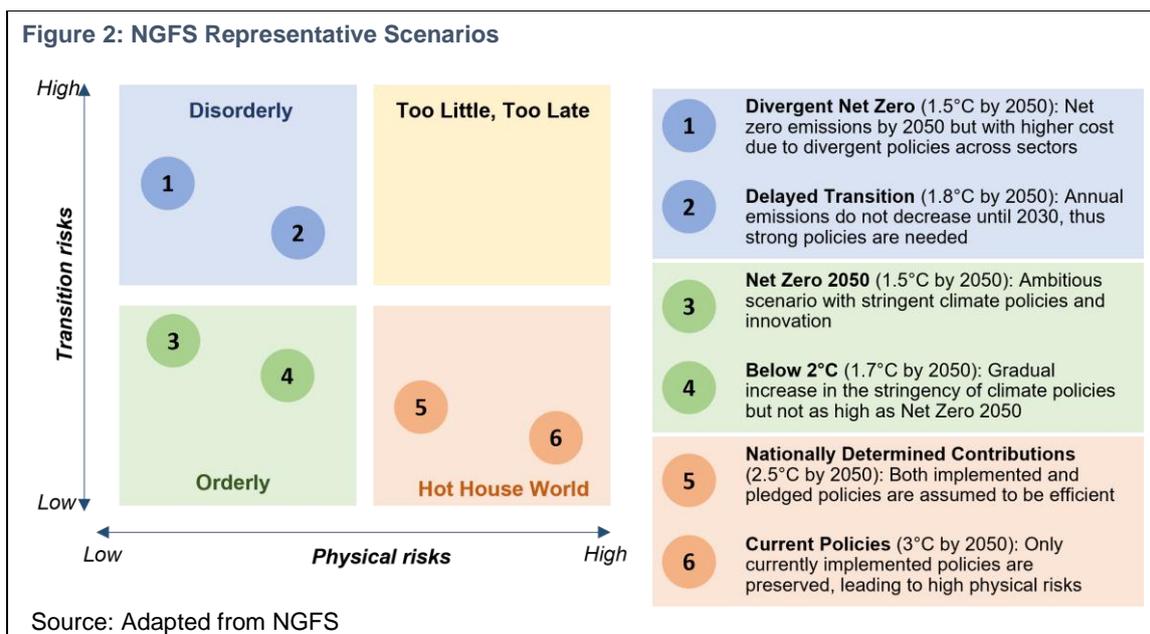
Building on the scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA), the NGFS developed a set of scenarios¹⁰ exploring the impact of climate change and climate policies with the aim of providing a common reference framework for various users. Each NGFS scenario category explores a distinct set of assumptions for how policies, emissions and temperatures evolve and the consequent transition and physical risks from a macro-financial perspective (Figure 2):

- i. **Orderly:** The transition towards a low carbon economy is assumed to occur in a predictable manner and allows for climate objectives to be reached. This results in both physical and transition risks to be relatively subdued.
- ii. **Disorderly:** Higher transition risks occur, due to policies being delayed or divergent across countries and sectors. For example, carbon prices are assumed to increase abruptly after a period of delay.
- iii. **Hot House World:** Some climate policies are assumed to be implemented in some jurisdictions, but global efforts are insufficient to halt significant global warming. These scenarios result in severe physical risks materialising, including irreversible impacts like sea-level rise.

Six scenarios were then developed for three of the categories to allow central banks and supervisors to explore a range of lower and higher risk outcomes.

⁹ Refer to Box 1 for more details of the NGFS scenarios, including the Orderly scenarios.

¹⁰ A detailed description of the NGFS scenarios can be found [here](#).



5.6 As highlighted in paragraph 2.5, these scenarios should not be treated as forecasts of future climate trajectories; rather, they are intended as explorations of potential future climate conditions, with different assumptions embedded in each scenario. In this regard, their different respective outcomes are useful for testing the resilience of the financial institutions under markedly different climate futures.

5.7 As part of the 2024 CRST exercise, the Bank will provide selected climate and macroeconomic variables for all prescribed scenarios (see Table 1), which would incorporate the added impact from the second half of the century in one of its scenarios (see paragraph 5.16). The Bank expects that the climate variables which embody physical and transition risks will be based on the high-level global and regional pathways as simulated by the NGFS, which have been downscaled and calibrated to individual countries, including Malaysia.¹¹ The Bank will be engaging the relevant subject matter experts to consult on the appropriate application of the downscaled information for Malaysia and the necessary calibrations.

Table 1: Indicative Scenario Variables¹²

Climate Variables	Macroeconomic Variables	Financial Market Variables
Physical variables <ul style="list-style-type: none"> Near-surface air temperature Transition variables <ul style="list-style-type: none"> Shadow carbon price pathway Emissions pathway Global and domestic energy prices Energy consumption and mix 	<ul style="list-style-type: none"> Real gross domestic product (GDP) (aggregate and by expenditure components) Gross value added (GVA) by selected sectors Inflation Unemployment Short-term interest rate Property price index 	<ul style="list-style-type: none"> Long-term interest rate/ bond yield Exchange rates (MYR/USD) Equity price index

5.8 For chronic physical risk variables, the primary focus will be on the near-surface air temperature pathways. The Bank is also considering providing information on acute physical risk variables which would relate to the frequency and severity of major perils (such as floods) in Malaysia. While the acute physical risk variables are challenging to model in terms of their macroeconomic and financial markets impacts,

¹¹ Refer to [NGFS Scenario Explorer](#) and [NGFS Climate Impact Explorer by Climate Analytics](#).

¹² All variables are for Malaysia only unless otherwise indicated.

they are especially useful for financial institutions to assess the potential direct losses from such events.

- 5.9 For transition risk, the variables would include shadow carbon price and emission pathways. The shadow carbon price is a proxy for required policy intensity (that may cover a range of fiscal and regulatory policies such as carbon taxation, cap-and-trade schemes, and subsidies) given assumptions on climate policy (in terms of ambition, timing, and distribution across sectors), and technology change (in regard to energy sources and efficiency, as well as carbon sequestration, including measures related to agriculture, forestry and land use).¹³ These assumptions vary across the three scenarios based on the respective pathways for temperature and emissions. In addition, simulations of global and domestic energy prices, as well as energy consumption by fuel type (energy mix) in Malaysia will help to inform the energy transition process of the country under the different scenarios.
- 5.10 The physical and transition risk variables for Malaysia will be mapped to key aggregate macroeconomic and financial variables, for example GDP, inflation, unemployment, interest rates, exchange rates, and asset prices. These variables would simulate the combined impact from the physical and transition risks associated with each scenario. No additional shocks beyond the climate-related ones will be incorporated into the macroeconomic model simulation. The evolution of macroeconomic and financial variables following the climate-related shocks will also consider fiscal and monetary policy reactions. For fiscal policy, this would include assumptions on carbon pricing and how the associated revenue will be utilised. Regarding monetary policy, this would relate to assumptions on the reaction to risks to inflation and GDP growth.
- 5.11 Temperature increases, associated with different emission trajectories, will influence the GDP growth path via lower productivity, which could affect the labour market and capital stock, and through negative shocks to aggregate demand.¹⁴ Transition risks are more apparent under the Delayed Transition scenario following an unanticipated sharp shift in the stringency of mitigation policies. This reflects the confluence of macroeconomic effects associated with changes in global energy prices and consumption, the domestic carbon pricing, and the domestic energy mix and efficiencies. For example, when carbon pricing is imposed globally, lower global demand and hence lower (pre-tax) prices for fossil fuels will have a negative terms-of-trade effect, though partially offset by lower prices for imports. Meanwhile, with domestic carbon pricing, firm profits are reduced and energy inputs in production decline. This has a constraining effect, especially in the short term, on investment and potential output (absent offsetting efficiency gains), with repercussions for the labour market and aggregate demand. The pass-through of costs associated with the carbon pricing to consumer prices will raise inflation.
- 5.12 The Bank is also considering the calibration of sectoral effects in terms of GVA, which will be indicative of the most affected sectors over the stress horizon, given the nature of initial emissions, as well as the transition paths.
- 5.13 The variables and impacts under the various scenarios are meant to serve as a common background and starting point for financial institutions' modelling and assessments. Notwithstanding this, financial institutions may need to perform further scenario expansion¹⁵ where necessary. For example, financial institutions with

¹³ The shadow carbon price, based on Integrated Assessment Models (IAM) utilised by the NGFS, is solely for the purpose of the stress test and is not necessarily reflective of the Government's plans for carbon pricing policies.

¹⁴ The calibrated impact is based on estimates by Kalkuhl and Wenz (2020) using panel data across 77 countries for the period 1900 to 2014. The regression model, as utilised by the NGFS, assesses the immediate and long-term effects of temperature change on per capita growth.

¹⁵ 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.

climate-related risk exposures outside of Malaysia may be required to expand the scenario paths across a range of geographies. In this instance, financial institutions will be expected to use the variables provided by the NGFS as a starting point. Further scenario expansion by financial institutions should be aligned with the scenario narratives provided by the Bank. Financial institutions are also expected to undertake the necessary further steps for individual counterparty analysis.

- 5.14 In addition to the scenario variables provided in Table 1, the Bank has attempted to put together an initial list of potential data sources that may be useful for financial institutions to peruse for this exercise, including for the purpose of scenarios expansion, if any, and counterparty level assessment (see Appendix 4 and paragraph 7). The Bank acknowledges gaps in currently available data, hence where possible, limitations to these data sources have been highlighted in the appendix for further discussion, including on the potential for the industry to work together to source the relevant data. Refer to section 11 for more details on the industry's next steps.

Time horizon

- 5.15 Some physical impact of climate change such as rising sea levels and higher mean temperature will be incremental and are expected to materialise over an extended period. To ensure that the CRST exercise can capture the long-term nature of these risks, the Bank proposes for this exercise to cover an assessment horizon that spans several decades until 2050. This is aligned with the Paris Agreement where many jurisdictions, including Malaysia, are committed to striving for net zero GHG emissions or carbon neutral. Specifically, the CRST time horizon will span from December 2023 (as the base position) until 2050, with the first projection reporting period to be 2025. The following reporting periods will be the subsequent 5-year points throughout the stress test horizon i.e., 2030, 2035, 2040, 2045 and 2050.
- 5.16 Engagements with relevant government agencies and preliminary research suggest that the physical impact of climate change in Malaysia is already materialising with more physical risk events expected to occur later in the century. In anticipation of these events, the Bank proposes to bring forward the expected physical impact between 2050 and 2100 into the CRST time horizon. This is especially relevant for the Hot House World scenarios where the focus of the impact assessment is on physical risk. This approach is meant to mitigate any significant underestimation of the physical risk impact on the resilience of financial institutions. At the same time, this approach also reduces the need to further lengthen the assessment horizon which can introduce added complications and amplify uncertainty around modelling requirements. The Bank plans to collaborate with local climate experts to incorporate this impact into the scenario specifications. This could potentially manifest in increased frequency and/or severity of the physical climate events. The Bank is considering to reflect this under one of the Hot House World scenarios.

Questions on scenario narratives, time horizon and specifications (*please elaborate where relevant*):

3. Do the choice of scenarios, specifications and time horizon provide sufficient balance between allowing a full assessment of the climate-related risks while also being tractable for financial institutions' modelling capabilities?
4. In selecting scenarios to capture the impact of transition risks, the Bank opted for the Delayed Transition scenario given its plausibility in Malaysia's context.¹⁶ Do you agree with this approach?

¹⁶ For instance, the absence of carbon pricing policies in Malaysia at this juncture.

5. How relevant is the Divergent Net Zero scenario developed by NGFS, which assumes divergent policies across sectors, in the Malaysia's context?
6. Is there sufficient differentiation between the Current Policies and NDCs scenarios in Malaysia's context to warrant using both Hot House World scenarios in the CRST exercise, or would one or the other suffice?
7. Do you agree with the Bank's proposal to exclude orderly scenario(s) from the 2024 CRST exercise?
8. Beyond those proposed above, are there any other scenarios, informed by peer-reviewed research, that the Bank should consider?
9. Are there specific narratives or parameters relevant to Malaysia that the Bank should consider in refining the proposed climate scenarios beyond what has already been provided by the NGFS?
10. Are the climate, macroeconomic and financial variables adequate in capturing the climate-related risks in the proposed scenarios, allowing for further scenario expansion, if any? Are there other climate, macroeconomic or financial variables that the Bank should consider providing for this exercise?
11. Are there any other external data sources that can be added to the current list in Appendix 4?
12. Would the proposed assessment horizon (i.e., 30 years) adequately capture the impact of climate-related risks on financial institutions? What are the potential challenges that financial institutions might face in meeting this requirement, e.g., methodology, processes, technology, and data limitations?
13. Do you agree with the Bank's proposal to bring forward the materialisation of physical risks (expected in the second half of the century) into the CRST time horizon?

6 Financial risk coverage

- 6.1 Ideally, the Bank envisions for the 2024 CRST exercise to be as comprehensive as possible where the impact of the various climate scenarios will be assessed on all financial risk exposures of financial institutions. Nevertheless, the Bank acknowledges the challenges to achieve this, especially given current limitations in data and modelling capabilities. Hence, the Bank plans to request banks to quantify climate-related impacts from a credit risk perspective only while ITOs to quantify from market, and insurance and takaful risks perspectives (Figure 3).
- 6.2 The proposal for banks to focus the quantitative impact of climate-related risks on credit risk for this exercise is in line with credit risk exposures comprising the most significant portion of banks' balance sheet (approximately 60% of total banking system assets). This approach is also largely consistent with global practices where most banking climate stress tests are designed to assess the impact from credit risk at the minimum. For ITOs, exposures from insurance/takaful and market risks remain the largest with aggregate capital held for these risks accounting for 43% and 38% of total capital required, respectively. Meanwhile, market risk is not only relevant for life and family ITOs, but has also become increasingly notable for general ITOs, given their increased exposures to financial assets via the holding of Collective Investment Schemes (CIS), and direct investments in bonds.
- 6.3 The Bank proposes for the impact from other risk types (e.g., liquidity and operational risks) to be assessed qualitatively during the CRST exercise in 2024 (Figure 3). For this purpose, the Bank plans to provide a qualitative questionnaire which may include areas such as financial institutions' views on the potential direction of risks arising from the climate scenarios and plans to improve the relevant risk management areas. Assessing these risks, albeit qualitatively, remains important to enhance financial institutions' understanding of the various transmission channels and to provide useful

insights into the overall climate impact. The quantification of such risks may be considered in future CRST exercises.

- 6.4 Specifically, for ITOs, worsening climate events could also lead to sustained upward pressure on insurance and takaful rates. Over the long term, this could result in climate-related coverage becoming unaffordable for customers or unfeasible for ITOs to offer. Recognising this, the Bank proposes for the assessment surrounding insurance and takaful pricing to be covered as part of the qualitative assessment.

Figure 3: Coverage of Financial Risks for Financial Institutions

Banks:



ITOs:



Questions on coverage of financial risks (please elaborate where relevant):

Banks

14. Do you agree with the Bank's proposal to quantify the climate impact on banks from a credit risk perspective only?
15. Does your institution currently have, or plan to have, resources and capability to quantitatively model the climate-related risks impact from credit, market, liquidity, and operational risks perspective over a 30-year horizon?
16. Besides the risk channels listed above, are there other significant risk channels that are relevant for banks in Malaysia and should be considered by the Bank?

ITOs

17. Do you agree with the Bank's proposal to quantify the impact of climate change from insurance and takaful, and market risks perspectives only?

18. Does your institution currently have, or plan to have, resources and capability to quantitatively model the climate-related risks impact from insurance/takaful, market, credit, liquidity and operational risks perspective over a 30-year horizon?
19. Besides the risk channels listed above, are there other significant risk channels that are relevant for ITOs in Malaysia and should be considered by the Bank?

7 Portfolio exposure scope and granularity

Banks

- 7.1 The Bank proposes for the scope of the 2024 CRST exercise to primarily focus on banks' domestic exposures to businesses and households. In addition, exposures to businesses and households in banks' overseas operations should also be accounted for. Banks are to consider the impact on their assets from both physical and transition risk perspectives, ranging from high-level to more granular specifications for the different portfolios.
- 7.2 To estimate the impact of climate-related risks on credit losses, banks are expected to adopt robust modelling techniques combined with expert judgement across the different scenario pathways. The Bank proposes for banks to assess the materiality of climate-related risks for existing business lines and portfolios based on the scope and level of granularity set out in paragraphs 7.3 to 7.5.
- 7.3 *Business exposures*
- (a) Climate-related risks have the potential to affect businesses through transition risks (e.g., increase in costs due to carbon pricing) and physical risks (e.g., severe disruption to operations due to damage of premises and equipment). When projecting credit losses from businesses, banks are to consider both their loan and bond investment portfolios. The Bank proposes for the assessment to be conducted at the sectoral-level (i.e., leveraging on sectoral-level macroeconomic/financial variables that will be provided by the Bank), complemented by a more granular assessment at the counterparty-level.
 - (b) In this regard, the Bank has considered a list of sectoral breakdowns (refer to Appendix 5). These economic sectors have been identified for this exercise based on their sensitivity to changes in transition and physical risks. For counterparties with diversified business lines that are not listed in Appendix 5, the Bank proposes for these counterparties to be classified based on the respective main economic activity or sector of their parent group.
 - (c) The counterparty-level analysis involves deeper scrutiny on cashflows and earnings of individual firms. To enable sufficient coverage of risks, the Bank recommends for the scope of this assessment to:
 - (i) Include at least the top 100 individual business counterparties (entity level) based on exposure size, or those with exposures of more than RM10 million, whichever is larger; and
 - (ii) Comprise the top 5 counterparties in each economic sector, if the firm is not already part of condition (i).

Notwithstanding this, the Bank strongly encourages banks to extend the counterparty level analysis beyond their top 100 firms.
 - (d) The Bank expects banks to actively engage with counterparties and collect counterparty-level data such as ESG ratings and GHG emissions level to have a depth of understanding on how the transition and physical risk may affect them under each scenario. Where reliable or comparable climate-related data are not available, banks may consider using reasonable proxies and assumptions as alternatives in their assessment. When assessing the

materiality of climate-related risks, the Bank proposes the assessment to also consider the counterparties' climate mitigation and adaptation plans only if they are already under implementation and are highly likely to be completed. In this regard, banks may find it helpful to leverage on their CCPT classifications for each counterparty to identify each exposure's degree of transition to sustainable practices.

- (e) For the remaining business exposures that are not included in the counterparty level analysis, banks are expected to conduct sectoral-level modelling and may leverage on existing stress test credit models.

7.4 Household exposures

- (a) The large retail portfolio exposure of Malaysian banks are also increasingly vulnerable to climate change. By employing data that is commonly used in traditional stress tests, banks are to apply country-specific macroeconomic variables such as unemployment rate, GDP and changes in property prices to project credit losses from households arising from both transition and physical risks.
- (b) To provide better clarity on the drivers of climate-related losses, the Bank proposes banks to consider the exposure of households from the following portfolios:
 - (i) 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
 - Increased physical risk as severe physical climate events can cause significant damage to properties in a particular location and lead to property price discounts and lack of insurability
 - (ii) 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
 - Increased physical risk due to damages to vehicles from nature-related events like floods
 - (iii) Other household loans (e.g., unsecured lending, securities, etc.)
 - Contagion impact from borrowers with exposures to property and vehicle that are vulnerable to climate-related risks
 - Other possible forms of transition risk which would be relevant to this exercise
- (c) To assess the impact from physical risk events, the Bank proposes the assessment for paragraph 7.4 (b) (i) to be done at the postcode level for domestic exposures. The Bank proposes banks to also consider any indirect impacts from the macroeconomic developments, e.g., due to unemployment, higher inflation, labour supply, lower consumption, etc.

7.5 Overseas operations

- (a) In this context, overseas operations refer to domestic banking groups' overseas branches which have exposures to customers or counterparties outside Malaysia.
- (b) The Bank proposes the coverage of the assessment for overseas operations to be consistent with that of the domestic operations for both the business and household portfolios. While the Bank acknowledges that the assessment may not likely be as granular as that of the domestic exposures, the Bank expects banks to ensure that the level of granularity to be fairly commensurate to the size of exposures and risks faced in the respective jurisdictions.
- (c) For losses that are not quantifiable (e.g., due to data or modelling limitations), the Bank expects banks to outline in the qualitative questionnaire (as per

paragraph 6.3) how customers or individual counterparties are expected to be affected across the transition pathways, along with their climate mitigation and adaptation plans. Banks would also need to indicate the proportion of their exposures that are not quantifiable and assessed this way.

ITOs

7.6 For insurance and takaful risk assessment, the Bank proposes ITOs to assess the impact of physical and transition risks on claims, benefit payouts and liabilities.

(a) For general ITOs, this largely relates to the impact following potential increase in the severity and frequency of natural catastrophic events. From a transition risk perspective, liabilities of certain lines of business could also be affected by the increasing costs of insuring carbon-intensive industries or business activities. The Bank proposes the assessment to be conducted for the following lines of business:

- (i) Motor
- (ii) Fire
- (iii) Medical and health
- (iv) Marine, aviation, and transit
- (v) Personal accident
- (vi) Contractors' all risk and engineering
- (vii) Others

Specifically for the physical risk assessment, the Bank proposes the assessment to be done at the postcode level.

(b) For life and family ITOs, benefit payouts and liabilities could be affected by changes in mortality and morbidity rates arising from physical risk events, and other factors such as changes in policyholders' behaviour. Life and family ITOs are expected to conduct the necessary scenario expansion to produce the appropriate parameters for the specific actuarial assumptions under each scenario. For example, the assumed changes to morbidity and mortality rates must be commensurate with the chronic and acute physical risk scenarios, while changes in policyholders' behaviour may reflect the domestic economic situation at a point in time. The Bank proposes the assessment to be conducted at the insurance and takaful sub-fund level at the minimum i.e.;

- (i) Participating ordinary life
- (ii) Participating annuities life
- (iii) Non-participating ordinary life
- (iv) Non-participating annuities life
- (v) Investment-linked
- (vi) Individual takaful sub-funds

7.7 For market risk, all ITOs will be asked to revalue their financial assets and liabilities based on the prevailing financial market performance throughout the stress test horizon. For assets, all ITOs are to assess the impact by types of assets e.g., Government bonds, corporate bonds, equities, CIS, etc. Specifically for corporate bonds, the Bank proposes for the assessment to be done by rating categories (e.g., AAA, AA, A, government guaranteed, etc.).

Questions on portfolio exposure scope and granularity *(please elaborate where relevant):*

20. Do you agree with the proposed scope and level of granularity?

21. What are the challenges (e.g., specific data gaps or modelling limitations) that would impede your ability to model the assessment at the proposed scope and level of granularity?

Banks

22. Do you agree with the proposed scope for the counterparty-level assessment? If not, what would be a more appropriate threshold that the Bank should consider in determining the scope?
23. Beyond the sectors listed in Appendix 5, are there additional sectors that are crucial for banks to conduct the CRST exercise (e.g., due to materiality of banks' exposures to the sector or the sector's vulnerability to climate-related risks)? Is there a need for further granularity or a merging of some of the sectors?
24. How would you reflect judgements about counterparties' current mitigation and adaptation plan in the quantitative assessment?
25. Do you foresee challenges in estimating the impact on the SME segment based on the sub-sectors provided? Are there specific sector(s) that may be especially challenging?
26. Would your institution be able to assess the impact from the household segment based on the portfolio breakdown proposed?
27. To model climate-related risks for the household sector, what kind of data specifications may be useful to be standardised across the industry?
28. For domestic banking groups (DBGs) with exposures to both overseas subsidiaries and branches, have you considered the climate-related risk impact on your overseas subsidiaries as well?

8 Balance sheet approach

- 8.1 With the extended assessment horizon up to 2050, assessing the impact of the stress scenario on financial institutions' balance sheet presents a considerable challenge given the expected changes in the surrounding environment and industries. The Bank proposes financial institutions to assume a static balance sheet approach for the ease of implementation of this exercise. Financial institutions shall assume no change in lending exposure and strategy over time and only allow changes resulting from the direct materialisation of risks in the scenarios.
- 8.2 A key advantage of this approach is it helps to ensure that results from this exercise can be interpreted pertaining to current business models and are comparable across the industry. In addition, as financial institutions are unable to mitigate the impact through assumed management actions, it lowers the risks of underestimating the financial impact. However, this approach may be unrealistic, especially over longer time horizons given the evolution of the industry.
- 8.3 In contrast, a dynamic balance sheet approach would present more realism to the results as it allows for a shift in lending strategy to accommodate changes in the economy, capturing the feedback loop between the real and financial sectors. For example, increasing industry pressure may result in a financial institution divesting away from carbon-intensive industries and invest in greener sectors.
- 8.4 While the dynamic approach has its merits, it would pose additional challenges to financial institutions given the length of the time horizon. Modelling management actions at institutional level may not be desirable at this juncture since:
 - (a) It is resource-intensive due to the greater number of assumptions needed;
 - (b) It increases the risk of underestimation of the financial impact; and
 - (c) It could lead to inconsistencies between financial institutions, reducing comparability across the industry.

- 8.5 Notwithstanding this, the Bank proposes financial institutions to outline the potential management actions they expect to undertake under each scenario, and how these could affect the quantitative results as part of the supplementary qualitative questionnaire. This would be useful for financial institutions to start developing plans surrounding possible actions and changes in business strategies, and for the Bank to estimate the potential second-round impact to financial stability and the wider economy.

Questions on balance sheet approach *(please elaborate where relevant):*

29. What could potentially be useful to complement the static balance sheet approach given its limitation?
30. What are the possible challenges in reflecting and quantifying future management actions in the supplementary questionnaire?

PART C CONDUCT/FORMAT OF THE EXERCISE

9 Submission requirements

- 9.1 Similar to regular stress test exercises, the Bank proposes financial institutions to report the outcome of the 2024 CRST exercise based on a list of selected key metrics. Nevertheless, given the added dimensions that climate assessment presents (e.g., geographical locations and climate mitigation and adaptation plans), the Bank plans to request data from these aspects as well, either quantitatively or qualitatively, to provide sufficient insights into the relevant vulnerabilities and exposures.
- 9.2 The Bank plans to provide standardised templates for the quantitative reporting. Overall, the Bank proposes the quantitative outputs to be reported at base position (i.e., 2023), followed by an interval of five years starting from year 2025 until 2050 (refer to para 5.15).
- (a) Specifically for banks, the Bank proposes the following key metrics:
- (i) Exposure at default (RM million)
 - (ii) Estimated probability of default (%)
 - (iii) Estimated loss given default (%)
 - (iv) Total increase in expected credit losses (RM million)
 - (v) Increase in MFRS 9 Stage 2 and Stage 3 exposures during the year (RM million)
 - (vi) Top 5 individual business counterparties in each economic sector
- (b) For ITOs, the Bank proposes the following key metrics:
- (i) Surplus arising for life and family ITOs
 - (ii) Assets (e.g., property, plant and equipment, debt investments, equity investments, cash, and deposits etc.)
 - (iii) Liabilities (e.g., net life/family liabilities, and premiums and claims liabilities)
 - (iv) Premiums (at base position)
 - (v) Net benefit payouts for life and family ITOs
 - (vi) Net claims incurred by types of perils and lines of business for general ITOs

The lists above are not exhaustive and may be augmented, taking into consideration industry feedback.

- 9.3 In addition to aggregated figures, the Bank also proposes for financial institutions to report the key metrics specified under paragraph 9.2 based on the following dimensions:
- (a) Geographical location
 - (b) Sectoral breakdown
 - (c) Counterparty level
 - (d) Portfolio level

The scope and level of granularity for these dimensions are not expected to be more intensive than what have been proposed in Section 7. For example, the request for sectoral breakdown reporting for non-financial corporate exposures will be in line with the list proposed under paragraph 7.3 and will not be set at a more granular sub-sector level. Similarly, for ITOs, the breakdown by types of portfolio will at most be consistent with the lines of business and insurance/takaful sub-funds defined under paragraph 7.6. Any further granular breakdown beyond the stipulations under Section 7 may still be considered, but the reporting will be based on a best effort basis.

- 9.4 Additionally, financial institutions are also expected to fill up a qualitative questionnaire for selected financial risks. In addition to what have been mentioned in paragraph 6.3 and 8.5, financial institutions will also report their learning points and challenges in running the CRST exercise. This information is expected to inform, among others, future work priorities for both the industry and the Bank.

Questions on submission requirements:

31. Would the proposed key metrics accurately capture the climate-related risks faced by your institution? Are there any other metrics that you think the Bank should consider?
32. Do you agree with the proposed breakdown/dimensions for the quantitative submissions?
33. Are there other areas that you think the Bank should consider when preparing the qualitative questionnaire?

10 Governance

- 10.1 Financial institutions will be expected to have in place an internal governance process around the conduct of the CRST exercise and the data submission, consistent with the expectations set out in the CRMSA exposure draft. This includes effective challenges from senior management, including the relevant committees and the board of directors. The Bank expects all the key issues, considerations, approvals, and changes made following the deliberations to be recorded accordingly. The quantitative reporting templates and the qualitative questionnaire shall also be completed as accurately as possible.

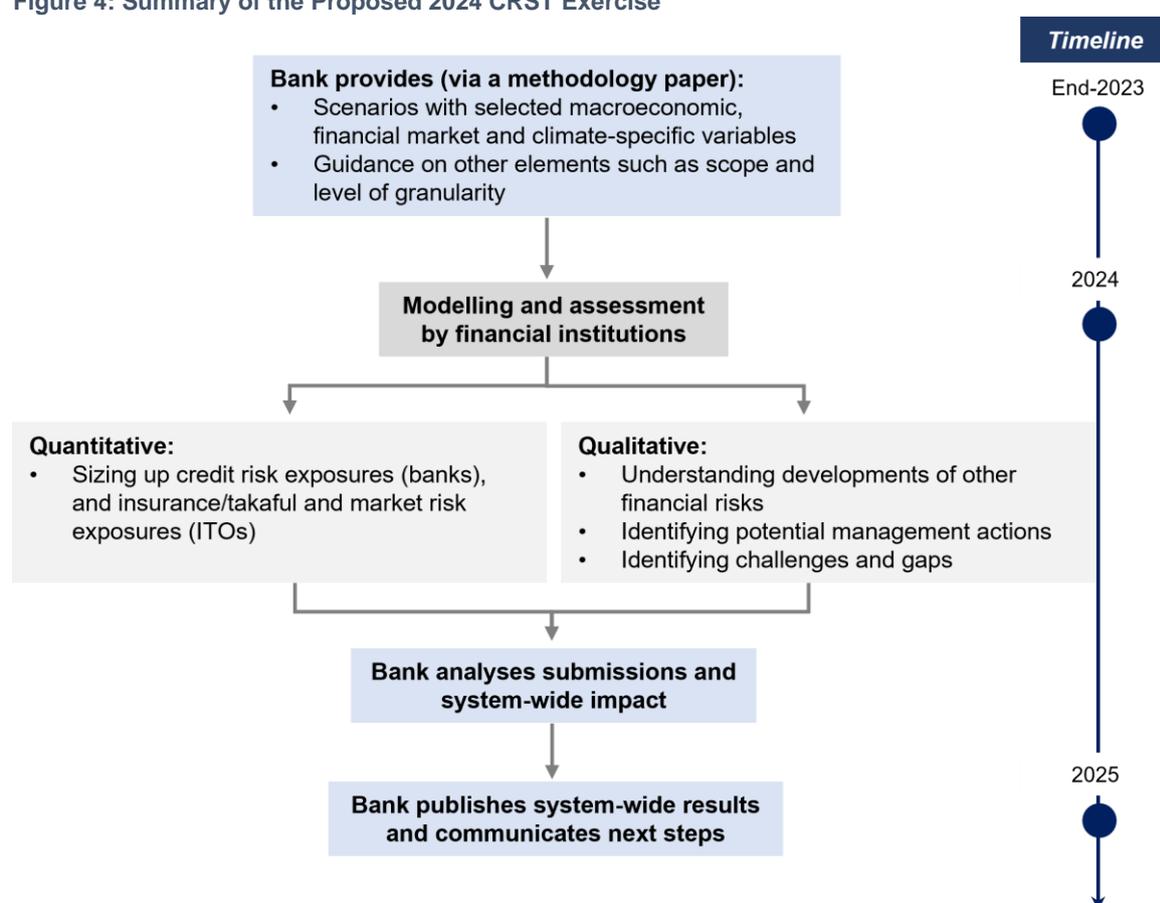
11 Next steps and timeline

- 11.1 In addition to the written feedback as invited in the beginning of this document, the Bank also plans to organise engagement sessions which may be conducted, among others, via the JC3 platform. An area particularly of interest is localisation of physical risk scenarios and variables, especially that for acute physical risk, to fit into the broader scenarios. The Bank invites local climate experts or institutions with the relevant solutions to reach out for potential collaboration on this area.
- 11.2 Data initiatives will also continue to be pursued via the JC3 Sub-committee on Bridging Data Gaps. In the immediate term, the Sub-committee will work with key public and private sector partners to identify critical data needs, including for the purpose of the CRST exercise, and map them to the relevant data sources. On this, a data catalogue is expected to be published by end-2022. Other longer-term initiatives by the Sub-committee are also underway, including efforts to address the limitation surrounding availability of sustainable financing and investment data, and forward-looking climate data.
- 11.3 Based on industry responses to this discussion paper and further engagements, the Bank will finalise the key elements of the CRST and publish a methodology paper by end-2023. The methodology paper will consist of the final scenarios, including the relevant variables, and guidance on other elements such as the expected risk coverage and level of granularity. Financial institutions will run the industry-wide CRST exercise in 2024 and be given sufficient time to complete the exercise, which covers both quantitative and qualitative elements. Based on the submission of results by financial institutions, the Bank intends to conduct an assessment to size up a system-wide impact and identify the relevant vulnerabilities. The Bank plans to

publish the aggregated results and immediate next steps by 2025 (refer to Figure 4 for the summary of the exercise).

- 11.4 While the Bank does not plan to publish financial institution-specific results, the Bank may share some indicative ranges of outcomes to provide more insights on climate impact. The results will also supplement supervisors' knowledge of individual institutions' vulnerability to climate-related risks, as well as their governance and management of these risks.

Figure 4: Summary of the Proposed 2024 CRST Exercise



- 11.5 The industry plays an essential role to the success of this exercise. Hence, in the run-up to the exercise, the Bank strongly recommends financial institutions to begin accelerating existing efforts to strengthen their capabilities in assessing and managing climate-related risks, in line with the various complementary initiatives highlighted in paragraphs 1.3 and 1.4. This can include building the necessary data infrastructure, models, and resource capacity to assess climate-related risks. Financial institutions are also strongly encouraged to exchange relevant knowledge and expertise, and collaborate where possible, leveraging on platforms such as the JC3 Sub-Committees to conduct knowledge sharing sessions and to advance certain strategic collaborations such as data collection.

- 11.6 While the Bank recognises the extent of effort and capacity building needed for the 2024 CRST exercise, the Bank expects financial institutions to adopt a long-term view when investing in internal capabilities. The level of sophistication, quality and granularity of the climate risk stress testing techniques are expected to become more complex over time, especially as other important elements such as the consideration of liability risk (in addition to physical and transition risks), and the

interlinkages between climate change and biodiversity loss¹⁷ are incorporated. As such, it is crucial for the industry to kickstart the process now, with the intention to further refine the stress testing scope and technical capabilities in the future.

Questions on next steps and timeline:

34. Do you agree with the proposed broad timeline?
35. Based on the overall CRST proposals, how long do you think your institution would need to run the exercise?
36. Do you have suggestions on potential agencies or service providers that the Bank could collaborate with in relation to the localisation of physical risk scenarios?
37. Data gap remains a key challenge. How do you think the industry can effectively work together to secure the essential data needs for the purpose of this exercise? Kindly refer to Appendix 4 on potential data gaps at this juncture that would require further effort by the industry. Please provide practical examples in the context of this exercise.

¹⁷ Refer to the joint Bank Negara Malaysia - World Bank research paper on [“An Exploration of Nature-Related Financial Risks in Malaysia”](#).

PART D APPENDICES

Appendix 1 Principles for climate risk management and scenario analysis

Governance	<p>Principle 1: The board and senior management shall exercise effective oversight of climate-related risks to safeguard the financial institution’s resilience against the adverse impacts of climate change. Financial institutions shall clearly identify the relevant responsibilities for managing climate-related risks and assign these responsibilities throughout the organisation structure. Financial institutions shall manage climate-related risks proportionate to the materiality of climate-related risks, taking into consideration the size, nature and complexity of the financial institutions’ business model.</p> <p>Principle 2: The board and senior management shall ensure that they have a sound understanding of climate-related risks to inform the financial institution’s business and risk management strategies.</p> <p>Principle 3: Financial institutions shall embed climate-related risks into their internal control frameworks across the three lines of defence to ensure the robust management of material climate-related risks.</p>
Strategy	<p>Principle 4: Financial institutions shall incorporate the potential impact of material climate-related risks into their business strategies to strengthen resilience against climate-related risks and support orderly transitions.</p>
Risk Appetite	<p>Principle 5: Financial institutions shall embed climate-related risks into the risk appetite framework, including the potential long-term impact of these risks as drivers of existing types of material risks. Financial institutions shall reflect these material risks in the internal capital adequacy assessment process.</p>
Risk Management	<p>Principle 6: Financial institutions shall integrate material climate-related risk considerations into their existing enterprise-wide risk management framework. This must be supported by a reliable approach to identifying, measuring, monitoring and controlling material risks.</p> <p>Principle 7: Financial institutions shall continuously develop data capabilities, tools and methodologies to effectively aggregate and report material climate-related risks.</p> <p>Principle 8: Financial institutions shall consider climate-related risks as part of comprehensive risk assessments to identify and measure all material risks.</p> <p>Principle 9: Financial institutions shall actively monitor and escalate material and potential climate-related risks in a timely manner. This is supported by appropriate data, risk analysis and clear reporting procedures.</p> <p>Principle 10: Financial institutions shall put in place appropriate risk controls when managing current and potential impact of material climate-related risks. Financial institutions shall implement controls in a timely manner to mitigate the potential build-up in concentration to climate-related risks, in line with the risk appetite and business strategy.</p> <p>Principle 11: Climate-related risks can have a significant impact on other major risk types. In this regard, financial institutions shall understand the transmission and impact of climate-related risks on existing risk types and</p>

	ensure their risk management systems and processes account for material climate-related risks.
Scenario Analysis	<p>Principle 12: Financial institutions must employ scenario analysis to determine the resilience of their business strategies to material climate-related risks. Given the complexity and evolving nature of these risks, insights from the scenario analyses shall inform the risk profile, risk appetite and risk management framework.</p> <p>Principle 13: Financial institutions must ensure scenario analysis exercises are relevant, follow certain prescribed and well-known standards, are conducted at appropriate time horizons and contain sufficient level of granularity. This is proportionate to the materiality of climate-related risks associated with the financial institutions' business and operations.</p>
Disclosure	Principle 14: Financial institutions shall produce reliable, meaningful and comparable climate-related disclosures, to support informed decisions by stakeholders and reinforce the effective management of material climate-related risks in the financial sector.

Appendix 2 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 should not be treated as exhaustive and does not signal the Bank's preference for a particular modelling approach.

Paper	Source
Overview of Environmental Risk Analysis by Financial Institutions	NGFS (2020)
Case Studies of Environmental Risk Analysis Methodologies <i>See 'Part I ERA for Banks' and 'Part II ERA for Institutional Investors and Insurers'</i>	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 (2021)
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 <i>Various guides and resources. 'Scenario Analysis – Data and tools providers spreadsheet', in particular, contains a list of 3rd party vendors for climate models/frameworks</i>	CFRF

Appendix 3 Full list of discussion questions

1. Are there any other factors that the Bank should consider when setting the scope of participation and level of applicability of the 2024 CRST exercise?
2. What kind of challenges would your institution face in order to conduct the analysis on overseas operations' exposures?
3. Do the choice of scenarios, specifications and time horizon provide sufficient balance between allowing a full assessment of the climate-related risks while also being tractable for financial institutions' modelling capabilities?
4. In selecting scenarios to capture the impact of transition risks, the Bank opted for the Delayed Transition scenario given its plausibility in Malaysia's context¹⁶. Do you agree with this approach?
5. How relevant is the Divergent Net Zero scenario developed by NGFS, which assumes divergent policies across sectors, in the Malaysia's context?
6. Is there sufficient differentiation between the Current Policies and NDCs scenarios in Malaysia's context to warrant using both Hot House World scenarios in the CRST exercise, or would one or the other suffice?
7. Do you agree with the Bank's proposal to exclude orderly scenario(s) from the 2024 CRST exercise?
8. Beyond those proposed above, are there any other scenarios, informed by peer-reviewed research, that the Bank should consider?
9. Are there specific narratives or parameters relevant to Malaysia that the Bank should consider in refining the proposed climate scenarios beyond what has already been provided by the NGFS?
10. Are the climate, macroeconomic and financial variables adequate in capturing the climate-related risks in the proposed scenarios, allowing for further scenario expansion, if any? Are there other climate, macroeconomic or financial variables that the Bank should consider providing for this exercise?
11. Are there any other external data sources that can be added to the current list in Appendix 4?
12. Would the proposed assessment horizon (i.e., 30 years) adequately capture the impact of climate-related risks on financial institutions? What are the potential challenges that financial institutions might face in meeting this requirement, e.g., methodology, processes, technology, and data limitations?
13. Do you agree with the Bank's proposal to bring forward the materialisation of physical risks (expected in the second half of the century) into the CRST time horizon?
14. **[Banks only]** Do you agree with the Bank's proposal to quantify the climate impact on banks from a credit risk perspective only?
15. **[Banks only]** Does your institution currently have, or plan to have, resources and capability to quantitatively model the climate-related risks impact from credit, market, liquidity, and operational risks perspective over a 30-year horizon?
16. **[Banks only]** Besides the risk channels listed above, are there other significant risk channels that are relevant for banks in Malaysia and should be considered by the Bank?

17. **[ITOs only]** Do you agree with the Bank's proposal to quantify the impact of climate change from insurance and takaful, and market risks perspectives only?
18. **[ITOs only]** Does your institution currently have, or plan to have, resources and capability to quantitatively model the climate-related risks impact from insurance/takaful, market, credit, liquidity and operational risks perspective over a 30-year horizon?
19. **[ITOs only]** Besides the risk channels listed above, are there other significant risk channels that are relevant for ITOs in Malaysia and should be considered by the Bank?
20. Do you agree with the proposed scope and level of granularity?
21. What are the challenges (e.g., specific data gaps or modelling limitations) that would impede your ability to model the assessment at the proposed scope and level of granularity?
22. **[Banks only]** Do you agree with the proposed scope for the counterparty-level assessment? If not, what would be a more appropriate threshold that the Bank should consider in determining the scope?
23. **[Banks only]** Beyond the sectors listed in Appendix 5, are there additional sectors that are crucial for banks to conduct the CRST exercise (e.g., due to materiality of banks' exposures to the sector or the sector's vulnerability to climate-related risks)? Is there a need for further granularity or a merging of some of the sectors?
24. **[Banks only]** How would you reflect judgements about counterparties' current mitigation and adaptation plan in the quantitative assessment?
25. **[Banks only]** Do you foresee challenges in estimating the impact on the SME segment based on the sub-sectors provided? Are there specific sector(s) that may be especially challenging?
26. **[Banks only]** Would your institution be able to assess the impact from the household segment based on the portfolio breakdown proposed?
27. **[Banks only]** To model climate-related risks for the household sector, what kind of data specifications may be useful to be standardised across the industry?
28. **[Banks only]** For domestic banking groups (DBGs) with exposures to both overseas subsidiaries and branches, have you considered the climate-related risk impact on your overseas subsidiaries as well?
29. What could potentially be useful to complement the static balance sheet approach given its limitation?
30. What are the possible challenges in reflecting and quantifying future management actions in the supplementary questionnaire?
31. Would the proposed key metrics accurately capture the climate-related risks faced by your institution? Are there any other metrics that you think the Bank should consider?
32. Do you agree with the proposed breakdown/dimensions for the quantitative submissions?
33. Are there other areas that you think the Bank should consider when preparing the qualitative questionnaire?
34. Do you agree with the proposed broad timeline?
35. Based on the overall CRST proposals, how long do you think your institution would need to run the exercise?

36. Do you have suggestions on potential agencies or service providers that the Bank could collaborate with in relation to the localisation of physical risk scenarios?

37. Data gap remains a key challenge. How do you think the industry can effectively work together to secure the essential data needs for the purpose of this exercise? Kindly refer to Appendix 4 on potential data gaps at this juncture that would require further effort by the industry. Please provide practical examples in the context of this exercise.

Appendix 4 Indicative list of potential data sources

Below are selected data sources that may be useful for purpose of the CRST exercise. This list should not be treated as exhaustive and does not signal the Bank's preference for a particular data source. Some of these data sources will also be featured in the Data Catalogue by JC3 Sub-committee on Bridging Data Gaps that is expected to be published by 2022.

Data item	Potential sources	Remarks
All NDC targets (including Malaysia)	UNFCCC	The source contains detailed information on NDC pledges across countries. This information may be useful to understand the national policies of which the overseas branches are operating in, as well as to understand the details of Malaysia's NDC plans and commitments.
Energy-efficiency indicators	IEA	The database contains annual data from 2000 covering energy consumption by energy product, carbon emissions and associated indicators across four sectors of final consumption (residential, services, industry, transport). The data may be useful for transition risk analysis from household exposures, for example, through the residential sector. Detailed information is available upon subscription.
Environmental, Social & Governance (ESG) score/rating	BURSA – ESG Rating MSCI – ESG Rating Individual companies' statements or reports	May be useful for counterparty level assessment. Where data are insufficient or unavailable, financial institutions need to engage directly with counterparties (e.g., through industry collaboration) or use reasonable proxies and assumptions as alternatives.
GHG emissions (scope 1, 2, 3)	Individual companies' statements or reports	
Green / Sustainable stock / bonds market and indices	ACMF Climate Bonds BIX FTSERUSSELL	May be useful for both sectoral and counterparty level assessment. For counterparty level assessment, where data are insufficient or unavailable, financial institutions need to engage directly with counterparties (e.g., through industry collaboration) or use reasonable proxies and assumptions as alternatives.
Green building	Green Building Index GreenRE	Given the data on green certified buildings by projects and developers, this may be useful for transition risk analysis at counterparty level assessment, particularly for the real estate sector.

Mortality rate	World Bank	Life and family ITOs may find this useful for insurance and takaful liability risks analysis.
NGFS scenarios	NGFS Scenario Portal NGFS Scenario Explorer	Useful to understand the detailed narratives of the NGFS scenario and obtain the relevant projected variables that are available at regional and selected national levels (e.g., emissions and macroeconomic variables). May be useful for scenarios expansion and for analysis on overseas operations.
Projected climate impacts based on NGFS scenarios and other relevant scenarios such as the IPCC scenarios	Climate Impact Explorer	More granular data is available for Malaysia (including at the state level) and other countries. May be useful for scenarios expansion and for analysis of overseas operations.
Projected climate variables across countries based on SSP scenarios	Worldbank – Climate Change Knowledge Portal	Projections based on SSP scenarios for more granular climate variables such as number of hot days, number of frost days, days with precipitation exceeding 20mm and sea level rise, for Malaysia and other countries. May be useful for scenario expansion and analysis of overseas operations.
Statistics of vector-borne and communicable diseases in Malaysia	Portal Data Terbuka	The database contains statistics on vector-borne and communicable diseases such as malaria, dengue haemorrhagic fever and cholera in Malaysia. May be useful for scenario expansion, specifically on mortality and morbidity modelling by ITOs.

Appendix 5 Indicative list of sectoral breakdown

Sector	Sub-sector
Agriculture, forestry, and fishing	Oil palm Paddy Rubber Livestock Fishing/aquaculture Forestry and logging Other agriculture
Mining and quarrying	Mining of coal and lignite Extraction of crude petroleum Extraction of natural gas Other mining and quarrying
Manufacturing	Food products and beverages Tobacco products Textiles and apparel Automotive Furniture Wood, paper and paper products Rubber and plastic Building materials Electrical and electronic products Others
Construction	Construction of buildings Civil engineering
Services	
Electricity, gas, steam, and air conditioning supply	Coal generation Natural gas generation Petroleum generation Nuclear generation Wind generation Solar generation Hydroelectric generation Other generation Electricity delivery
Water supply; sewerage, waste management and remediation activities	Water supply Sewerage, waste management
Wholesale and retail trade; repair of motor vehicles and motorcycles	Wholesale and retail trade – automotive Wholesale and retail trade – others
Accommodation and food service activities	Hotels & restaurants
Transportation and storage	Land transport; transport via pipelines Water transport Air transport
Information and communication	Information and communication
Financial and insurance/ takaful activities	Financial and insurance/ takaful activities
Real estate activities	Real estate activities
Others	Other services

PART E GLOSSARY

Bottom-up	A bottom-up approach to climate stress testing is when a firm uses its own framework as part of a system-wide or supervisory exercise.
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, that are sources of financial 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.
ESG	ESG (environmental, social and governance) refers to a set of criteria that plays a role in the investment decision-making process or in a company's operations. Environmental factors consider how an investment or a company contributes to environmental issues such as climate change and sustainability. Social factors examine the social impacts of an investment or a company on communities. Governance relates to transparency and legal compliance of an investment or a company's operations, for instance in terms of accounting and shareholders' rights.
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 (H ₂ O), carbon dioxide (CO ₂), nitrous oxide (N ₂ O), 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 ₂ O and CH ₄ , the Kyoto Protocol deals with the GHGs sulphur hexafluoride (SF ₆), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). GHG emissions are separated into three scopes: <ul style="list-style-type: none"> • Scope 1 covers direct emissions from owned or controlled sources. • Scope 2 covers indirect emissions from purchased electricity consumed by the reporting entity.

	<ul style="list-style-type: none"> • Scope 3 covers indirect emissions from assets not owned or activities not controlled by the reporting entity along its value chain (upstream and downstream).
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	<p>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.</p> <p>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.</p>
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 (NDC)	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	<p>Economic costs and financial losses resulting from the increasing severity and frequency of weather events or longer-term shifts in climate patterns. This includes indirect effects of climate change such as loss of ecosystem services (e.g., desertification, water shortage, degradation of soil quality or marine ecology).</p> <ul style="list-style-type: none"> • Acute physical risk refers to the increased severity and frequency of extreme weather events such as heatwaves, landslides, floods, wildfires, and storms. • Chronic physical risk refers to longer-term gradual shifts of the climate such as changes in precipitation, ocean acidification and rising sea levels and average temperatures.
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	<p>The risks related to the process of adjustment towards a low-carbon economy.</p> <p>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.</p>
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

PART F 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
DFIA	Development Financial Institutions Act
EMEAP	Executives' Meeting of East Asia Pacific Central Banks
ESG	Environmental, social and governance
FSA	Financial Services Act
GDP	Gross domestic product
GHG	Greenhouse gas
GVA	Gross value added
IAIS	International Association of Insurance Supervisors
IAM	Integrated Assessment Models
IEA	International Energy Agency
IFSA	Islamic Financial Services Act
IPCC	Intergovernmental Panel on Climate Change
ITOs	Insurers and takaful operators
JC3	Joint Committee on Climate Change
NDCs	Nationally Determined Contributions
NGFS	Network for Greening the Financial System
NGOs	Non-governmental organisations
SIF	Sustainable Insurance Forum
SME	Small and medium enterprise
SSP	Shared Socioeconomic Pathways
VBIAF	Value-based Intermediation Financing and Investment Impact Assessment Framework

PART G REFERENCES

- Alogoskoufis, S. (2021). 'ECB economy-wide Climate Stress Test: Methodology and Results'. European Central Bank, 281.
- APRA. (2021). 'Climate Vulnerability Assessment'. Australian Prudential Regulation Authority.
- Allen et. al. (2020). 'Climate-Related Scenarios for Financial Stability Assessment: An Application to France'. Banque de France.
- ACPR. (2019). 'French Banking Groups Facing Climate Change-Related Risks'. Autorité de Contrôle Prudentiel et de Résolution, 101.
- BCBS. (2022). 'Principles for the Effective Management and Supervision of Climate-Related Financial Risks'. Basel Committee on Banking Supervision.
- BoC-OSFI. (2022). 'Using Scenario Analysis to Assess Climate Transition Risk'. Bank of Canada and Office of the Superintendent of Financial Institutions.
- Baudino, P., and Svoronos, J.P. (2021). 'Stress-Testing Banks for Climate Change – A Comparison of Practices'. Bank for International Settlements, 34.
- BCBS. (2021). 'Climate-Related Financial Risks – Measurement Methodologies'. Basel Committee on Banking Supervision.
- BCBS. (2021). 'Climate-Related Risk Drivers and Their Transmission Channels'. Basel Committee on Banking Supervision.
- BOE. (2021). 'Guidance for Participants of the 2021 Biennial Exploratory Scenario: Financial Risks from Climate Change'. Bank of England.
- BOE. (2021). 'Key Elements of the 2021 Biennial Exploratory Scenario: Financial Risks from Climate Change'. Bank of England.
- BCBS. (2020). 'Climate-Related Financial Risks: A Survey on Current Initiatives'. Basel Committee on Banking Supervision.
- BOE. (2019). 'A Framework for Assessing Financial Impacts of Physical Climate Change: A Practitioner's Aide for the General Insurance Sector'. Bank of England.
- BOE. (2019). 'General Insurance Stress Test: Scenario Specification, Guidelines and Instructions'. Bank of England.
- BOE. (2019). 'Life Insurance Stress Test: Scenario Specification, Guidelines and Instructions'. Bank of England.
- BOE. (2019). 'The 2021 Biennial Exploratory Scenario on the Financial Risks from Climate Change'. Bank of England.
- Clerc et. al. (2021). 'The Main Results of the 2020 Climate Pilot Exercise'. Autorité de Contrôle Prudentiel et de Résolution, 122.
- Carlin et. al. (2021). 'UNEP FI's Comprehensive Good Practice Guide to Climate Stress Testing'. United Nations Environment Programme Finance Initiative.
- Clerc et. al. (2020). 'Scenarios and Main Assumptions of the ACPR Pilot Climate Exercise'. Autorité de Contrôle Prudentiel et de Résolution.
- ECB. (2021). 'Climate Risk Stress Test: SSM Stress Test 2022'. European Central Bank.

- ECB. (2021). 'Climate-Related Risk and Financial Stability'. European Central Bank.
- Economic Planning Unit. (2021). 'Twelfth Malaysia Plan'. Federal Government of Malaysia.
- EIOPA. (2022). 'Methodological Principles of Insurance Stress Testing – Climate Change Component'. European Insurance and Occupational Pensions Authority.
- EIOPA. (2020). 'Second Discussion Paper on Methodological Principles of Insurance Stress Testing'. European Insurance and Occupational Pensions Authority.
- EIOPA. (2019). 'Methodological Principles of Insurance Stress Testing'. European Insurance and Occupational Pensions Authority.
- Ens, E., and Johnston, C. (2020). 'Scenario Analysis and the Economic and Financial Risks from Climate Change'. Bank of Canada.
- Ismail Yaakob. (2021). 'Komitmen Malaysia Dalam Menerajui Agenda Perubahan Iklim Negara'. Kenyataan Media Yab Perdana Menteri.
- Ismail Yaakob. (2021). 'Ucapan Yab Dato' Sri Ismail Sabri Yaakob Perdana Menteri Malaysia Semasa Membentangkan Usul Mengenai Rancangan Malaysia Kedua Belas, 2021-2025: Keluarga Malaysia – Makmur, Inklusif, Mampan Di Dewan Negara'.
- Jung, H., Engle, R., and Berner, R. (2021). 'Climate Stress Testing'. Federal Reserve Bank of New York, 977.
- Kalkuhl, M., and Wenz, L. (2020). 'The Impact of Climate Conditions on Economic Production. Evidence from a Global Panel of Regions'. *Journal of Environmental Economics and Management*, 103.
- Krznar et. al. (2022). 'Climate Risk Analysis in FSAPs'. International Monetary Fund.
- Ministry of Environment and Water. (2020). 'Malaysia: Third Biennial Update Report to the UNFCCC'. Federal Government of Malaysia.
- NGFS. (2021). 'NGFS Climate Scenarios for Central Banks and Supervisors'. Network for Greening the Financial System.
- NGFS. (2021). 'Scenarios in Action: A Progress Report on Global Supervisory and Central Bank Climate Scenario Exercises'. Network for Greening the Financial System.
- NGFS. (2020). 'Guide to Climate Scenario Analysis for Central Banks and Supervisors'. Network for Greening the Financial System.
- NGFS. (2020). 'Overview of Environmental Risk Analysis by Financial Institutions'. Network for Greening the Financial System.
- NGFS. (2020). 'The Macroeconomic and Financial Stability Impacts of Climate Change: Research Priorities'. Network for Greening the Financial System.
- NGFS. (2019). 'A Call for Action: Climate Change as a Source of Financial Risk'. Network for Greening the Financial System.
- Tang K.H. (2019). 'Climate Change in Malaysia: Trends, Contributors, Impacts, Mitigations and Adaptations'. Curtin University Malaysia.
- TCFD. (2017). 'The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities'. Task Force on Climate-Related Financial Disclosures.
- Viegas et. al. (2021). 'Global Workshop on Climate Scenario Analysis and Stress Testing'. Bank of England.

Vermeulen et. al. (2018). 'An Energy Transition Risk Stress Test for the Financial System of the Netherlands'. DeNederlandscheBank, Vol. 16(7).