Basel Committee
on Banking Supervision

Discussion Paper

The role of climate scenario analysis in strengthening the management and supervision of climate-related financial risks

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Chapter 1: Introduction

In 2022, the Basel Committee on Banking Supervision (Committee) issued *Principles for the effective management and supervision of climate-related financial risks* (Principles) to promote a principles-based approach to improving both banks' risk management and supervisors' practices related to climate-related financial risks. The Principles encouraged banks to use climate scenario analysis (CSA) to assess the resilience of their business models and strategies to a range of plausible climate-related pathways and to determine the impact of climate-related risk drivers on their overall risk profile. Supervisors were also encouraged to determine that, where appropriate, banks apply climate scenario analysis.

The Principles acknowledged that the field of scenario analysis is highly dynamic, and practices are expected to evolve rapidly, especially as climate science advances. For this reason, the Committee is undertaking targeted work with respect to banks' use of CSA, building on work under way in other global forums.

The Committee is issuing this discussion paper to gather feedback from stakeholders on a range of topics related to the practical application of CSA and its role in strengthening the management of climate-related financial risks. Based on the feedback received through this consultation and building on the work under way in other global forums (eg the Financial Stability Board (FSB) and Network for Greening the Financial System (NGFS)), the Committee will consider complementary work in pursuit of its mandate to strengthen the regulation, supervision and practices of banks worldwide with the purpose of enhancing financial stability.

In 2023, the Committee began monitoring jurisdictions' implementation of the Principles to promote a common understanding of supervisory expectations and support the development and harmonisation of strong practices across jurisdictions.[1] That work reinforced the importance of CSA as a forward-looking tool to assess the resilience of banks' business models and strategies to a range of plausible climate-related pathways and determine the impact of climate-related risk drivers on their overall risk profile. At the same time, the Committee found that uses and methodologies vary across jurisdictions and banks, and data availability and methodological uncertainty can be limiting factors in CSA meeting its stated objectives. The heterogeneity of scope, features, objectives and approaches of CSA exercises across jurisdictions limit the harmonisation of supervisory expectations and the comparability of results.

There are a number of possible objectives of CSA, including to identify the potential impacts of climate-related financial risks on individual exposures, on aggregated exposures or asset classes, and on banking groups. CSA is typically used for exploring how both the transition towards a low-carbon economy and the consequences of increasing physical risks may impact macroeconomic and financial variables, and ultimately, it explores the risks to financial institutions' balance sheets and business models. CSA can therefore play an important role in strategic planning and the management of climate-related financial risks within financial institutions.

As with traditional stress testing, CSA is a forward-looking approach that explores a range of plausible pathways that may significantly differ from "business-as-usual" assumptions. Traditional stress tests and CSA share similar framework components (eg scenarios, risk models). However, the two exercises typically differ in terms of the scenarios they use. While traditional stress tests explore severe but plausible scenarios such as economic downturns or recessions associated with transitory macroeconomic and financial shocks, CSA exercises focus on structural and short-term changes in the economy arising from transition and/or physical risks. Accordingly, this discussion paper often refers to existing stress testing

[1] See BCBS, "Newsletter on the implementation of the Principles for effective management and supervision of climate-related risks", 21 November 2023, for a summary of the findings of this work.

frameworks and approaches as a starting point, but also draws attention to important differences in scenarios, analytical frameworks and exercise design.

Chapter 2: Current objectives in the Basel Framework

Through the publication of the Principles in June 2022, the Committee sought to promote a principles-based approach to improving both banks' risk management and supervisors' practices related to climate-related financial risks. While the Principles seek to accommodate a diverse range of banking systems and are intended to be applied on a proportionate basis, with regard to CSA and stress testing they were formulated with a view towards application to large internationally active banks and to supervisory and other relevant financial authorities in Committee member jurisdictions.

References to CSA are explicitly included in principles 12 and 18, while principles 5, 9 and 15 contain expectations that climate-related financial risks assessed as material over relevant time horizons be incorporated into banks' internal (and supervisors' review of) capital and liquidity adequacy assessments, including stress testing programmes where appropriate. However, the Principles were issued at a high level in recognition that the management of climate-related financial risks, including CSA, is currently evolving and is expected to mature over time.

The supervisory review process (SRP) promotes the assessment of traditional financial risks using historical data and time horizons that reflect the typical crystallisation of these financial risks. Typical supervisory tools may not reflect potential losses that may arise from climate-related risks, as historical data on loss patterns have limited predictive capacity for future losses arising from structural changes in the economy and as climate-related risks are expected to materialise more frequently over varying time horizons. The Principles therefore envision a role for CSA in bridging the assessment of climate-related financial risks alongside and within existing supervisory tools. The annex provides a table with a summary of objectives of CSA and climate stress testing (CST) within the Principles and aligns them to respective documents within the Basel Framework. [2]

CSA and CST can be classified according to four main objectives:

a. risk identification

b. risk management processes

c. internal and supervisory capital and liquidity assessments

d. assessment of business model resilience and business strategy building

Each may therefore play a role in supporting financial institution efforts to address climate-related financial risks across these four areas.

Risk identification

Sound risk management seeks to ensure the comprehensive and timely identification of risks posed by a bank's lending, investing, trading, securitisation, off-balance sheet, fiduciary and other significant activities at the business-line and bank-wide level. The Principles highlight that banks are expected to identify all

[2] For the purposes of this paper, we use the terminology in BCBS, *Climate-related financial risks - measurement methodologies*, which identifies CST as a subset of CSA that evaluates the effects of severe but plausible climate scenarios on the resiliency of financial institutions. In this paper, the term CSA is inclusive of CST. The paper will specifically refer to CST where these approaches are uniquely appropriate.

climate-related financial risks that could materially impair their financial condition, including where these risks could impact the resilience of their business models and risk profiles.

The output of CSA could help identify which specific exposures are vulnerable to certain climate risk drivers. Additionally, CSA can allow for the incorporation of feedback loops, which can provide information the flow of risk beyond direct impacts as well as facilitate the study of multiple simultaneous shocks and other compound risks.[3] This enables banks to map their long-term strategy to various scenario pathways to assess the impact of climate-related risk drivers on their overall risk profile and the resilience of their business models. CSA can therefore improve the identification and assessment of climate-related financial risks by assessing a bank's vulnerabilities to specific climate risk drivers, quantifying concentrated exposures to and potential losses from climate risk drivers, and evaluating the continued viability of certain business lines and products.

On a portfolio level, supervisors should ensure that banks have the capacity to identify, measure, monitor and control risk concentration in their supervisory processes to complement the regulatory framework of large exposures and identify concentrated exposures from lending to certain sectors or within geographic locations. Accordingly, banks are expected to have the capacity to support customised identification of risk concentration (SRP 30.15 (2)).

The output of CSA may be helpful in assessing the extent to which groups of exposures are correlated to transition risk drivers, through identifying and measuring the impact of potential transmission channels of transition risk drivers on individual exposures and specific groups of exposures. For example, CSA may be able to leverage carbon prices or government subsidies to identify concentrations across a range of sectors or counterparties, providing a more detailed risk-informed measure of risk concentration than by aggregating general exposure classes or types.

For physical risks, CSA can help address the challenge of identifying risk concentrations in hazards and chronic effects that are geospatially determined. CSA may inform the appropriate level of geographic granularity, the reliability of existing risk mitigants (eg insurance, adaptation) and the potential for correlations across seemingly uncorrelated locations. Furthermore, CSA may also aid the quantification of risk concentrations in multiple risk drivers, such as the impact of extreme weather events on physical properties and electrical grid reliability.

Risk management processes

CSA exercises may also be useful in a range of risk management processes, including:

- remediating important gaps in data and methodologies for risk assessment,
- evaluating potential losses under a range of severe but plausible climate scenarios,
- pricing exposures,
- determining exposure or risk limits,
- monitoring, and
- controlling the exposures.

Thus, CSA exercises may help banks assess how the exposures evolve over time with respect to key performance indicators and exposure limits as well as to mitigate risk that exceeds the banks' risk tolerance.

[3] For a review of current and possible future integration of compound risks into climate scenario analysis, see NGFS, *Compound risks: implications for physical climate scenario analysis*, November 2023.

Notwithstanding the maturity and time horizons that drive most risk management processes, effective risk management may necessitate assessments that reflect longer time horizons to understand the risks associated with business and portfolio strategies and to evaluate the timing of potential risk mitigation options. CSA could be a useful tool to explore these considerations.

Internal and supervisory capital and liquidity assessments

CSA, and CST in particular, could help ensure that the bank's internal capital and liquidity assessments appropriately reflect climate-related financial risks. Within the existing supervisory framework, the supervisory evaluation process is intended to generate an active dialogue between banks and supervisors such that when insufficient capital or deficiencies are identified, decisive action can be taken to restore capital or address deficiencies. Such active dialogue between banks and supervisors could inform how climate-related financial risks are incorporated into capital and liquidity assessment processes.

Assessment of business model resilience and business strategy building

The outcomes of climate scenario analysis can be inputs to inform banks' strategies and risk management concerning transition, which could in turn be reflected in banks' risk management processes. On one hand, long-term scenarios can be employed to study the potential effects on banks' profitability and the growth prospects of economic structural changes, such as those related to a transition to a low-carbon economy or the potential discontinued availability of insurance to absorb tail risks. On the other hand, short-term scenarios can help assess banks' vulnerability to more immediate changes in economic and market environments resulting from shocks that have a short-term impact (three to five years), for example, those triggered by policy or regulatory changes. Both analyses can be viewed as complementary and may need to be incorporated into the internal business strategies and risk management processes undertaken by banks to prepare for both risks and potential changes in business models associated with a transition to a low-carbon economy and the physical effects of climate change.

Q1. How does the role of CSA vary based on the objectives listed above, and are there other prudential objectives where CSA could be relevant?

Constraints for the application of scenario analysis and stress testing

On its work to monitor the implementation of the Principles, the Committee found that while progress has been made in recent years, uses and methodologies vary across jurisdictions and banks, and data availability and methodological uncertainty can be a limiting factor to fully incorporate CSA into banks' risk management frameworks. Supervisory climate scenario exercises have been a catalyst for building banks' resources and capability. These exercises have also helped identify data and methodological gaps.

One of the potential obstacles for this integration is that while transmission channels of climate-related financial risks are increasingly understood, many have not been entirely captured in CSA yet. This poses challenges to the construction of scenarios combining macro-financial shocks and climate-related shocks (ie evaluating the interaction across climate and macroeconomic risk drivers). Additionally, there are gaps in the quality of observed data and a lack of future pathways of relevant variables for CSA. This limits further the modelling methodology that can be used and makes it difficult to identify material transmission channels and measure potential financial impacts.

Although further methodological work may still be required to fully incorporate climate-related financial risks into risk management frameworks, the continued accumulation of knowledge on climate-related financial risks can promote the development of risk management methodologies generally and the identification of material transmission channels relevant for specific banks and supervisory tools, such as use of the Internal Capital Adequacy Assessment Process (ICAAP).

> Q2. What are the key challenges in the application of CSA and how can they be overcome?
>
> Q3. What are the key areas where CSA methodologies and capabilities need to be further developed to be useful and relevant for the different objectives listed in this paper?

Chapter 3: Key features and usage-specific considerations for CSA

In seeking to advance common practices for CSA, the Committee has provisionally identified key features and usage-specific considerations for CSA exercises conducted by banks and supervisors. These initial considerations are intended to foster a robust dialogue on the design, implementation and use of CSA by banks and supervisors and channel industry and supervisory efforts towards collective progress on these exercises. At the same time, the Committee recognises that the field of CSA practices is advancing dynamically, and both banks and supervisors should therefore build sufficient capacity and expertise to conduct CSA exercises as part of their prudent management of climate-related financial risks. The Committee welcomes broad feedback on these considerations from a range of stakeholders, including the identification of features that have not yet been noted in this discussion paper.

Key features

Based on the Committee's initial work, it has identified seven key features of CSA: motivation, comprehensiveness, plausibility, coherence, transparency, tractability and proportionality. These features would be relevant to all CSA exercises conducted by banks or supervisors.

Motivation

CSA should have clearly articulated and formally adopted objectives. The motivation of the CSA exercise is a key feature that guides the design of the scenarios, the characteristics and scope of the exercise, the development of modelling frameworks and the use of results. These objectives should drive the development of frameworks, be adequately documented and be clearly communicated to all relevant stakeholders. All usage-specific considerations should be logically linked to the articulated exercise objectives.

Comprehensiveness

A CSA exercise should enable the assessment of material and relevant risks, as identified by sound risk identification processes, and be consistent with the articulated exercise objectives. The CSA suite should ideally capture all material risks identified within the objectives, considering the nature and composition of the institution or type of exposures in focus.

Plausibility

CSA exercises should reflect plausible future states of the world and potential real-world events, including extreme events that may currently seem unlikely but are nevertheless plausible in the context of climate change.[4] Assumptions within scenarios and frameworks should be clearly grounded in relevant scientific, technological and economic literature, even when simplified or abbreviated assumptions are used due to existing data or modelling challenges. Scenario assumptions and their rationale should reflect the most recently available information from credible experts, particularly for scientific and technological assumptions, and should be supported by rigorous analytics. Similarly, modelling assumptions should consider how historical relationships may plausibly shift to reflect structural shifts in economic and climate conditions analysed by the scenarios.

Coherence

The CSA suite, including scenario design, risk analysis, modelling and overall exercise design should be internally coherent, both within the climate scenarios themselves and across the process used to translate scenarios into results. Assumptions about technological change, demographics, climate impacts and macroeconomic factors should demonstrate internal consistency within and across scenarios and models. Particular attention should be given to coherence of economic and financial variables derived from climate-related risk drivers, including the incorporation of technological shifts and scientific evidence on climate change as they become more clearly articulated.

Transparency

Climate scenarios should be sufficiently transparent and accessible to relevant users, including outputs, assumptions and sources of uncertainty. Scenario components should succinctly describe the assumptions and drivers of quantitative outcomes and differences across scenarios, supported by the economic or financial rationale for the observed pathways of variables in scenarios. The main assumptions and modelling approaches should be clear and understandable to senior management and supervisors. For the relevant governance and management of model risk, risk analysis models should be designed transparently so that exercise results have clear attribution to key risk drivers and transmission channels, and they should be accompanied by detail on sources of uncertainty.

Tractability

The development of CSA suites should strive to be flexible and reproducible. Scenario developers should be able to flexibly adapt scenarios to changing operating environments, particularly as the structural changes being analysed are increasingly reflected in current conditions. Shocks from climate-related financial risks should be mapped to economic and financial variables used by banks and supervisors in a reproducible manner, and historical series of the variables should be provided where appropriate. If possible, the magnitude of the impacts given in the scenarios should be replicable.

Proportionality

The depth and granularity of a CSA exercise should be proportionate to the materiality of the risk – to the extent that the materiality has already been established – to the institution and its capabilities. The design of both the scenarios and the analytical framework should consider the nature and composition of the institution, the business line, the sectors or the regions in focus.[5]

[4] One characteristic of physical risk events is that the speeds at which their frequencies and severities will increase are largely unknown. Accordingly, events that seem to be currently extreme and unlikely, based on historical data, are seeing their frequency and/or their severity increase in largely unpredictable ways. See also the section on severity of scenarios under usage-specific considerations.

[5] See principles 8 and 9 in BCBS, *Principles for the effective management and supervision of climate-related financial risks*, June 2022 , and BCBS, *High-level considerations on proportionality*, July 2022.

Q4. Are the key features listed above appropriately calibrated for a range of CSA exercises, and should other features be considered?

Usage-specific considerations

The specific considerations of CSA exercises will likely vary depending on the objective of the exercise. Usage-specific considerations may include the degree of standardisation, time horizons, severity of scenarios, baseline selection, granularity, balance sheet assumptions, and analytical frameworks.

Degree of standardisation

One of the initial framework design choices for a CSA exercise is the degree of standardisation to be applied. Standardisation can include, among other things:

- providing on a common set of climate risk scenarios;
- utilising scenarios from specific scenario builders;[6]
- requiring the use of specific scenario variables;
- introducing required data elements;
- selecting particular asset classes, sectors or geographies;
- specifying modelling techniques; or
- requesting specific data outputs.

The objectives of the exercise should inform the degree of customisation employed within the exercise, and trade-offs made in making this decision should be discussed and communicated.

Standardisation aims to make it easier to compare results across participating banks to identify common transmission channels, observe relative risk differentials across banks based on portfolio exposure, and study systemic effects within economies and financial markets. However, standardisation may limit capturing idiosyncratic risk in a given bank strategy, risk profile and portfolio characteristics. For example, asset or collateral location may be a primary determinant of the physical hazards considered most relevant to a particular bank, and a standardised exercise that prescribes a location-specific hazard may obscure relevant risk factors for that bank.

Customised CSA is likely best suited for the needs of financial analysis for a particular bank, as it can be tailored to the specific risks faced by that bank. At the same time, greater degrees of customisation of a CSA exercise can limit a supervisor's ability to aggregate results for a banking system or compare approaches across banks to observe and promote best practices.

For supervisors, one additional consideration is the level of standardisation across different supervisory CSA exercises, as this may also make it easier for banks to successfully complete the exercises. Greater customisation may increase the resource intensity to conduct these exercises for internationally active banks required to complete multiple CSA exercises.

6 For example, the Network of Central Banks and Supervisors for Greening the Financial System (NGFS), International Energy Agency (IEA) and Intergovernmental Panel on Climate Change (IPCC).

There are two types of supervisory CSA exercises depending on the objective of the exercise: those conducted by individual banks (bottom-up) and those conducted by the supervisor (top-down).[7] Bottom-up exercises are typically tailored to each bank's risk profile but can be less comparable across banks and more resource-intensive. Top-down exercises are typically more standardised and easier to compare across banks, but they may be less specific to individual banks' risk profiles.

While bottom-up exercises may be more resource-intensive for banks, they typically require greater reliance on individual bank learning. This can be more effective in raising awareness of their own risk exposure, promoting capacity building in risk management practices and helping banks fill their own data and methodological gaps. Therefore, supervisors and banks can benefit from bottom-up exercises even in supervisory exercises.

Top-down exercises applied homogeneously to banks in a specific jurisdiction may be useful for supervisors to understand transmission channels across institutions and the overall aggregated impacts of climate-related risks to the banking system. Conversely, the heterogeneity of climate risk impacts that has been observed by recent CSA exercises may not be captured accurately by top-down approaches.

Time horizons

The time periods over which a scenario is projected and/or an analysis is conducted are driven by the purpose of the assessment. Intuitively, shorter time frames may be more useful to analyse one-time shocks such as the materialisation of acute physical risk and policy shocks. They may also be more meaningful for the banks to mitigate risks at an institutional level and for authorities to address near-term vulnerabilities. Meanwhile, longer time frames may need to be used to evaluate the resiliency of existing strategies and business models to long-term structural changes associated with physical risks and transition risks.

A key consideration for any CSA or CST exercise is to ensure the time horizons associated with both effective risk exposure (ie exposure maturity) and expected risk materialisation (ie shock manifestation) are consistent with the exercise objective. Exercises linked to existing supervisory tools, such as capital or liquidity adequacy assessments, prioritise time horizons associated with risk exposure given their implication on capital and liquidity resources. Thus, they will tend not to change for differing risk materialisations. Other exercises, particularly those informing business model resiliency or strategic planning, may prioritise risk materialisation to evaluate a wider range of outcomes. Different banking activities, banking products and types of exposures may warrant different time horizons when a CSA or CST exercise is conducted for a specific business line or type of exposure.

Most risk-based tools and assessments typically require time horizons that reflect the maturity and nature of the exposures. For credit risk, a time horizon of three to five years may correspond to most corporate lending (notwithstanding the fact that typical business relationships with corporate clients are much longer) and to consumer lending except housing mortgages, given the typical duration of lending exposures. However, lending products with long-term fixed maturities (such as mortgages or certain project financing) may require longer time horizons that reflect a bank's effective risk exposure. For market risk positions, time horizons would be unlikely to exceed a few months, with the possible exception of illiquid positions, which could reach up to a year. For liquidity risks, appropriate time horizons may be

7 The top-down, bottom-up terminology has alternative meanings depending on the context in which it is used. For example, in energy systems modelling, a top-down approach generally refers to modelling energy systems at a macroeconomic level, while a bottom-up approach generally refers to modelling at the technology or engineering level. In financial risk modelling, a top-down approach can refer to modelling exposures at an aggregated level, while a bottom-up approach can refer to modelling at the individual exposure level. For clarity, this discussion paper uses the terminology presented in BCBS, *Supervisory and bank stress testing: range of practices*, December 2017. It defines bottom-up or institution-run exercises as those in which the supervisors issue scenarios and guidance to the banks, which then run their own models and report the results to the supervisor. It defines top-down (supervisor-run) exercises as those in which the supervisors collect data from the banks and then use their own models and scenarios to assess the performance of the banks under stress.

limited to 30 days or even less, depending on expectations for cash flows and liquidity positions (eg overnight or intraday liquidity exposures) across a range of conditions.

Severity of scenarios

Climate scenarios can range in severity. They can map modal pathways of future plausible climate conditions, enabling assessment of impacts of economic dislocation implied by specific orderly and disorderly economic transitions and the climate-induced physical events associated with corresponding emissions pathways. Scenarios can also be used to examine tail risk outcomes, exploring extreme conditions that might arise from climate change and structural changes in socioeconomic systems. To date, the global supervisory community has focused on scenarios that typically describe modal macroeconomic and financial conditions, assuming fundamental but smooth structural changes in the economy from climate risk drivers over the longer term. Recently, increasing attention has focused on another type of scenario, often shorter term, that can assess preparedness and resilience to tail risk events from climate risk drivers.[8] Both types of scenario are important for understanding the impacts of future states of the world on banks' resiliency. Therefore, a range of scenarios with different severities will likely be needed, according to the objectives laid out for the CSA exercise and CST in particular.

Tail risk scenarios may be better for identifying and assessing resilience to potential vulnerabilities in stressed climate conditions, while modal pathways of future plausible climate conditions may be better for assessing business model resilience or assisting with strategic planning. Hazard-specific scenarios may be needed to target vulnerabilities for specific physical risk exposures, while macroeconomic scenarios may be required for enterprise- or banking sector-wide assessments. Where feasible, scenarios could consider interactions and correlations across risk drivers and economic agents as well as potential feedback effects and cumulative effects, provided all of these are grounded in research evidence.

Compound risk, where the interaction of two or more risks can result in a combined impact greater than their individual impacts, is a growing topic of discussion for CSA, and in particular CST, exercises.[9] Using multiple shocks to capture these compound risks and their cumulative impacts may be necessary to construct scenarios that appropriately reflect tail risks. In a climate context, as hazards can increase in frequency and intensity, the likelihood of multiple hazards and shocks occurring within the exercise's time horizon increases, including across physical and transition risks. CSA and CST exercises should consider incorporating compound climate risks to assess the impact of climate conditions, which may become more unstable and more extreme. Moreover, frictions (financial or non-financial) are constraints in financial markets and/or the real economy that hinder resource (eg labour, capital, etc) allocation and could amplify initial shocks, as these can harm the flexibility and resilience to deal with the impact of the climate situations. Accounting for frictions in the economy could make CSA scenarios more plausible and potentially more severe.

Regarding specifically how CSA, and CST in particular, may inform capital adequacy assessments in the future, scenarios would likely be sufficiently severe and consider feedback effects and compound risks, as capital is designed to cover stress losses associated with tail events. A potential consideration for scenario development may be to evaluate how climate risk drivers may interact with the macroeconomic shock events typically used in capital stress testing exercises. For example, a supervisory scenario could consider layering partial shifts in the structure of the economy (ie mid-transition) onto typical credit cycle shocks.

[8] See, for instance, NGFS, *Conceptual note on short-term climate scenarios*, October 2023.

[9] See, for instance, NGFS, *NGFS scenarios for central banks and supervisors*, September 2022.

Baseline selection

CSA is often operationalised following the established framework of stress testing, which assumes a certain baseline scenario. In the context of traditional stress testing, a baseline scenario is typically a non-stressed, central projection that serves as a basis of comparison for the other analysed scenarios. Moving from traditional stress testing to CSA and CST, analysts face a challenge in selecting such a central projection scenario due to varying impacts from transition and physical risks.

In CSA no realistic baseline excludes both physical and transition risks. Moreover, any baseline including physical and/or transitional climate risks incorporates a certain level of stress so that the alternative scenario may result in milder outcomes when measured against such a baseline scenario. This constitutes a departure from conventional stress testing and a challenge for adapting the existing framework.

De facto, some CSAs choose their conventional stress testing baseline, which typically does not incorporate climate impacts and is thus counterfactual. Other practical choices include a scenario considered to be the most likely outcome without any further climate policy responses. Such an outcome could be, for instance, a warming of 3°C, considering the world is currently on this pathway, or a transition to a low-carbon society by 2050. Either choice is more informed and realistic than the use of the counterfactual baseline, which assumes that neither climate change nor policy-driven transition will happen.

Granularity

Traditional scenario exercises, particularly capital stress testing, tend to explore scenarios at the macroeconomic level with risk drivers conveyed as shocks to critical macroeconomic variables (MEV) such as unemployment, inflation, interest rates and equity prices. The relevance of MEV-level granularity reflects the exposure of banks' solvency to aggregate risks within the broader economy and the focus of solvency at the consolidated level. In bottom-up supervisory exercises, banks often construct more granular scenarios from MEV-level variables to run their own models.

By contrast, CSA exercises are often expressly concerned with changes in these structural relationships, for example, a shift in energy systems, changing supply chains or reduced availability of insurance. Consequently, scenarios and exposure data for CSA may require greater granularity to appropriately evaluate changes in economic relationships. For scenario analyses that focus on direct effects of climate risk drivers, granular sectoral/geographical drivers are expected to provide keener insights than aggregated-level risk drivers.

Sufficiently granular data needed to assess dynamics within and across sectors or geographies may not be collected or available in a readily accessible format. Alternatively, proxies may be used to replace missing data. In general, greater degrees of granularity in scenario design and data collection often come with greater costs, including for data acquisition and expertise resources. Banks and supervisors should carefully consider the costs and benefits of using proxy data or reducing granularity or consider using data available from alternative sources such as national weather services or statistical offices. Special care should be taken to consider an appropriate level of granularity that can achieve the stated objectives of an exercise.

Balance sheet assumptions

Assumptions about the evolution of balance sheets over the chosen time horizon may impact the results of CSA exercises. Generally, balance sheets can be held static at their current levels, or they can be allowed to adjust over the time horizon – with each approach serving different purposes for assessing climate risks and having its own limitations.

Under a static balance sheet assumption, the size, composition and risk profile of a bank's exposures are held constant throughout the time horizon. A static balance sheet approach tends to prioritise the evaluation of risk drivers on exposures without accounting for mitigation responses through risk management actions. Seeing unmitigated results can provide bank management and supervisors useful information on the gross risk vulnerability and inform potential needs for risk management actions. Furthermore, several traditional supervisory stress tests impose this approach expressly to ensure results are free of subjective and beneficial balance sheet compositional changes or reductions in business volumes.[10] However, the further planning horizons extend beyond current asset durations, the less reliable static balance sheet assumptions are as reasonably realistic representations of future risk pathways, which limits their utility for identifying risk mitigation strategies or testing capital adequacy.

In contrast, dynamic balance sheet assumptions allow banks to assess the effects of possible adjustments to their strategies. The size, composition or risk profile of a bank's exposure are allowed to vary over the time horizon, either according to a specific set of rules prescribed by the supervisor or through the bank's assumptions about economic growth and commercial strategy. A dynamic balance sheet approach tends to prioritise a bank's reaction function to risk manifestation, which can illuminate possible risk management actions. These assumptions could facilitate an evaluation of a bank's options for mitigating climate risks and adjusting its strategic operating models. At the same time, the incorporation of the bank's strategy and client engagement and its resulting adjustments in financial positions or product and client mixes can dampen an assessment of risk vulnerability. Projecting management actions involves a high degree of speculation and judgment, including in regard to the constraints banks may face in implementing these adjustments, which can create additional modelling uncertainty. Moreover, presenting results that embed management action could mislead users if it is not clearly communicated that the results are contingent on these actions being taken.

While the selection of balance sheet assumptions will critically depend on the objective of the exercise, as with other CSA design choices, care must be taken to understand how underlying assumptions of economic, technological and climate changes within the scenarios may interact with these balance sheet assumptions. Where CSA exercises explicitly assess the impact of changes in underlying economic relationships, static balance sheets may not necessarily be appropriate. For example, in CSAs that consider long-term distributional changes in capital expenditures required to abate carbon emissions, it is necessary to assume sources of capital shift in tandem, while a static balance sheet assumption cannot make such assumptions. However, this may be appropriate as a practical approximation for shorter-term exercises where static balance sheets are used to assess the resiliency of current risk profiles.

Analytical frameworks

Many CSA exercises conducted to date have built on traditional stress testing frameworks and risk metrics, given their exploratory nature and a desire to build on existing infrastructure and knowledge. These traditional frameworks are generally designed to combine transitory shocks transmitted through macroeconomic scenario variables with models that project, among others, estimates of revenues, expenses, losses and provisions within their scope of analysis. Models are built to estimate standard risk measures, such as expected losses (comprising probability of default, loss given default and exposure at default parameters), net charge-offs, stressed profit and loss, value at risk, market valuations and credit valuation adjustments. Metrics used to evaluate performance in these frameworks can include dollar value losses by asset class, estimated net losses and the impact on capital or liquidity ratios. Most CSA exercises to date have used one or more of these traditional components as the backbone of their exercises. Some exercises have also added supplemental climate-specific metrics to evaluate climate risks, such as exposure-weighted financed emissions and share of income derived from emissions-intensive sectors.[11]

[10] See, for instance, BCBS, *Supervisory and bank stress testing: range of practices*, December 2017.

[11] See, for instance, European Central Bank, *Climate risk stress test: SSM stress test 2022*, October 2021.

These frameworks provided a reasonable initial foray into analysing the potential impacts of climate-related financial risks. However, as banks and supervisors seek to advance their approaches to CSA, it is also reasonable to question whether these frameworks (including measurement approaches and target outputs) remain fit for purpose to assess structural relationship breaks from historical experience. For example, stress testing models calibrated using historical data may embed an assumption that historical relationships and correlations hold into the future. Thus, reliance on stress testing models may be contingent on the particular objective of the CSA exercise, and new models may be needed where existing models are not fit for purpose. Similarly, metrics tied to typical risk management practices, such as capital or liquidity shortfalls, may have limitations in interpretation and actionability for longer-term analyses that require a significant number of assumptions.

Alternative frameworks may need to be developed to facilitate an assessment of bank performance, risk and viability under long-term structural changes. The integration of machine learning, artificial intelligence and big data analytics into the analytical framework could increase the capability of banks and supervisors to analyse and predict the impact of climate-related financial risks more effectively.

Q5. How does the design of CSA exercises vary depending on the objectives? Please elaborate on the main usage-specific considerations for each of the different objectives.

Q6. What additional usage-specific considerations are relevant for each of the different objectives of CSA listed in this paper and why?

Q7. Which scenario and scenario features are used for the different objectives listed above (ie internally developed, those from scenario builders or a combination of the two)?

Q8. What features and measures could be adopted in the future to enhance the utility of currently available scenarios (eg NGFS, IEA, IPCC)?

Q9. What alternative or novel approaches could supervisors consider for CSA and how might these be used for prudential purposes?

Q10. How could the effectiveness and efficiency of supervisory exercises be improved?

Chapter 4: Feedback on the discussion paper

The Committee welcomes comments from interested stakeholders on the different elements covered in this discussion paper by 15 July 2024. The Committee particularly welcomes feedback on the following questions:

Q1. How does the role of CSA vary based on the objectives listed above, and are there other prudential objectives where CSA could be relevant?

Q2. What are the key challenges in the application of CSA and how can they be overcome?

Q3. What are the key areas where CSA methodologies and capabilities need to be further developed to be useful and relevant for the different objectives listed in this paper?

Q4. Are the key features listed above appropriately calibrated for a range of CSA exercises, and should other features be considered?

Q5. How does the design of CSA exercises vary depending on the objectives? Please elaborate on the main usage-specific considerations for each of the different objectives.

Q6. What additional usage-specific considerations are relevant for each of the different objectives of CSA listed in this paper and why?

Q7. Which scenario and scenario features are used for the different objectives listed (ie internally developed, those from scenario builders or a combination of the two)?

Q8. What features and measures could be adopted in the future to enhance the utility of currently available scenarios (eg NGFS, IEA, IPCC)?

Q9. What alternative or novel approaches could supervisors consider for CSA and how might these be used for prudential purposes?

Q10. How could the effectiveness and efficiency of supervisory exercises be improved?

Annex: Correspondence of objectives of climate scenario analysis and climate stress testing from the Principles with other Basel Framework documents

Roles of climate scenario analysis (CSA) or climate stress testing (CST)	Principles	Basel Framework
Identify and quantify climate-related financial risks Incorporate risks assessed as material over relevant time horizons into their internal capital and liquidity adequacy assessment processes, including in their stress testing programmes where appropriate	Principle 5 (paragraphs 23–26)	BCP 15
Consider a sudden shock scenario for the trading book	Principle 9 (paragraph 39)	BCP 22
Assess the resilience of business models and strategies Determine the impact on the overall risk profile Identify relevant climate-related risk factors Measure vulnerability to climate-related risks Estimate exposures and potential losses Diagnose data and methodological limitations Inform the adequacy of risk management frameworks Inform the adequacy of risk mitigation options	Principle 12 (paragraphs 44–48)	BCP 15 Stress testing principles
Ensure banks identify and regularly assess the impact of climate-related risk drivers on their risk profile Ensure that material climate-related financial risks are adequately considered in their management of credit, market, liquidity, operational and other types of risk Ensure banks consider a range of mitigation options to manage and control material climate-related risks Ensure banks consider climate-related financial risks assessed as material over relevant horizons within their internal capital and liquidity adequacy assessments Ensure banks assess the resilience of their business models and strategies to a range of plausible climate-related outcomes	Principle 15 (paragraphs 56–57)	BCP17–25 Principles for sound liquidity risk management and supervision Principles for the sound management of operational risk Principles for operational resilience
Identify relevant risk factors Size portfolio exposures Identify data gaps and inform the adequacy of risk management approaches Evaluate a bank's financial position under severe but plausible scenarios	Principle 18 (paragraphs 63–66 and 68–69)	Stress testing principles