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Navigating Climate Headwinds: Reference Approaches for Scenario-based Climate Risk Measurement by Banks and Supervisors

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Executive Summary

Supervisors across the world are taking steps to develop and pilot different types of exploratory Scenario-based Climate Risk Measurement (SCRM) exercises to assess the impact on the financial system of physical and/or transition risks stemming from climate change. At the same time, many banks are now voluntarily conducting climate scenario analysis for internal risk management purposes, as input to disclosures, and to inform strategic decision making – such as setting climate-related targets and commitments.

Approaches to SCRM exercises can be differentiated into two main “buckets”: climate scenario analysis and stress testing. While scenario analysis and stress testing approaches have things in common – both are forward-looking and involve the use of scenarios to estimate financial impacts – there are important differences between the two tools, which affect their uses, design and potential applications in a prudential context.

While supervisory SCRM exercises to date have generally focused on the major firms

What’s In This Report?

- This report takes stock of emerging public sector and banking industry practices on the topic of Scenario-based Climate Risk Measurement (SCRM).
- The report discusses the important differences between “climate scenario analysis” and “climate stress testing,” and how these differences influence their uses, design and potential applications in a prudential context.
- It is necessary to make a number of design choices when developing an SCRM exercise. A risk of regulatory fragmentation in supervisory exercises is emerging if significantly different approaches are taken.
- To support greater consistency in supervisory and industry exercises, the IIF has developed a set of “Reference Approaches” as blueprints to guide thinking on the alignment of key design choices with different microprudential, macroprudential, and strategic objectives and applications.

¹ With thanks to Michaela Palmer for excellent research assistance.

headquartered in a particular jurisdiction, an increasing number of banks with cross-border operations are expected to participate in more than one jurisdictional exercise (see Section 2.1). Supervisory SCRMs exercises to date have varied notably in terms of objectives, approaches, time horizons, firms and risks in scope. Underlying design parameters and approaches have significant implications for the feasibility, outputs and ultimately the value of scenario analysis exercises, for both supervisors and firms. So far, most supervisors have been cautious in exploring potential prudential applications of supervisory SCRMs exercises, but the debate on when and how it may be appropriate to use the results of SCRMs exercises is advancing rapidly.

In the absence of a common international approach to the design and execution of supervisory SCRMs exercises, there is a clear risk of regulatory fragmentation. The NGFS Reference Climate Scenarios, while providing a critical foundation for climate scenario analysis, are currently not accompanied by formal international guidelines for supervisory exercises. Fragmentation could pose challenges for the development of globally consistent SCRMs frameworks by industry, and could strain industry capacity and resources during a phase of development and innovation (see Section 2.2). The significant variation between supervisory SCRMs approaches also reduces the comparability of different jurisdictional exercises, increasing complexity for banks, supervisors and the wider public to the extent that exercise results are published and intended to increase awareness of climate risk and how it is being managed.

Against this backdrop, the IIF conducted a stock-taking project with 20 large banks from across the world to assess experience with both supervisory and internal SCRMs exercises. As of July 2021, authorities in at least 18 national jurisdictions and the European Union have conducted, or announced an intention to conduct, an SCRMs exercise involving banking institutions, amounting to a total of at least 26 exercises. The majority (85%) of project participating banks have already engaged in or are preparing for supervisory exercises; 75% of the group have experience with supervisory exercises that have taken place or are currently underway.

Many IIF member banks believe that SCRMs exercises, including supervisory exercises, can play a critical role in enhancing understanding of the dynamics of future climate risks for both supervisors and firms; however, SCRMs practices are at a nascent stage, and remain complex. At this stage of development, supervisors can adopt certain approaches that foster capacity development, inform firms' strategic thinking, and facilitate participation, including leveraging the NGFS Phase II Reference Climate Scenarios, which the IIF recommends both firms² and supervisors refer to in their exercises. Effective approaches can include: early and open engagement; application of common approaches; provision of necessary data and tools or accommodation of data and methodological gaps; sharing best practices and cross-firm insights in the results among participating institutions. In addition, to

² An IIF survey indicates that 40% of the 20 project participating banks, and 46% in a wider sample of a sample of 28 IIF member financial institutions, already directly use or otherwise leverage the NGFS Phase I scenarios for their voluntary climate scenario analysis.

the extent that an exercise is intended to raise awareness, publishing sufficiently aggregated results to highlight key emerging trends, risks and opportunities can be useful.

During the current developmental phase for SCRM approaches, there are practical and conceptual benefits to differentiating supervisory SCRM exercises from other prudential activities, including macro-financial stress testing. Supervisory SCRM exercises could be conducted in a “regulatory sandbox” environment, until data, tools and understanding have improved to the point at which results are meaningful and comparable across firms. Moreover, it is critical that supervisory SCRM exercises do not “crowd out” banks’ internal analysis and capacity building efforts. To avoid balance sheet and operational fragmentation, and to enhance the clarity and comparability of exercise results, it is preferable that home authorities only require financial institutions to participate in an SCRM exercise on a consolidated basis, and that these exercises are not replicated on a local basis for subsidiaries. Instead, in the case of cross-border banking groups, relevant information should be disclosed by the home supervisory authority to host authorities.

While varying in scope and approaches, supervisory SCRM exercises to date have started to yield insights about the nature and potential materiality of climate-related financial risks for individual financial institutions, financial stability, and the broader macroeconomy. In aggregate, the potential economic and financial costs of climate risk impacts over the short to medium term appear to be moderate and manageable from a financial stability perspective; a range of studies indicate that over the next approximately 5-10 years system-wide risks are likely to be contained. However, beyond that horizon, longer-term climate-related risks can potentially be systemic, particularly under Hot house world scenarios (see Section 2.3). These findings exemplify the challenging ‘empirical tension’ stemming from climate risk horizons – while near-term risks are low, near-term action is required to reduce the potential for significant macro-financial risks to manifest in the future.

Recognizing the urgency of the climate crisis, it is crucial to consider how SCRM exercises can be most efficiently used to catalyze actions by banks, their clients, and supervisors to reduce potential firm-specific and system-wide climate-related risks and achieve the goal of an orderly transition to Net Zero with minimal risks to financial stability. SCRM exercises can contribute by helping to size risks, informing transition strategies, and targeting supervisory engagement and oversight. To achieve this shared goal, supervisors and firms should seek to coalesce around a set of priority analytical questions regarding future climate risks, and clarify how SCRM results can be appropriately leveraged to enhance awareness, create the right incentives, support better decision making, and inform bank-client engagement. Delivering on this objective requires greater alignment in how SCRM exercises are designed and conducted, and a common understanding of the role and limitations of forward-looking assessment in the context of the prudential supervisory and regulatory framework.

To contribute to the alignment of SCRM exercise design choices with key research questions for supervisors and banks, the IIF and its members have developed a proposed set of three **“Reference Approaches” for Scenario-based Climate Risk Measurement** (see **Figure ES.1**). These Reference Approaches can help orient the design of exercises towards

specific goals or analytical questions, and drive greater consistency in exercise design, implementation, and application. They provide a framework for aligning the key design choices inherent in SCRMs exercises – the scenarios, scope, the format and specification, key modelling assumptions, and outputs – with different microprudential, macroprudential, and strategic objectives and applications (see Section 3.2).

Figure ES.1: High-level Summary of Main Features of Three Reference Approaches for SCRMs Exercises (see Section 3.3 for a more detailed table)

	- Risk Time Horizon -		Present
	Future		
	Horizon Scanning “Sizing Future Risks”	Firm-level Assessment “Exploring the Dynamics”	Stressing Climate Risk Drivers “Testing for Vulnerabilities”
	<i>Macroprudential Lens</i>	<i>Macro/Microprudential Lens</i>	<i>Microprudential Lens</i>
Climate Risk Horizon	Long term: 2050-2080+	Medium term: 2030-2040	Near term: 1-5 year business planning horizon
Tool	Climate Scenario Analysis	Climate Scenario Analysis	Climate Stress Testing
Scenarios	Focus on Orderly Transition & Hot House World (NZ50, NDC, CP)* – oriented to 2050-80 endpoint	Focus on Disorderly Transition (DNZ, DT)* vs. Orderly Transition (B2C)* – oriented to 2030-40 endpoint	Severe but plausible scenarios (derived from NGFS) oriented to near-term financial resilience horizon
Scope	System-wide view on full set of transmission channels; credit risks most relevant	Sectoral view on specific transmission channels & feedback effects; credit, market, operational risks	Sector-specific view; can explore impact on specific risk stripes
Format and Specification	Supervisor- or Firm-conducted, top-down scoping	Firm-conducted, mix of top-down and bottom-up scoping	Firm-conducted using adapted bank internal models, bottom-up scoping
Modelling Assumptions	Simplifying modelling assumptions required	Dynamic balance sheet/management actions accounted for as much as feasible	Static balance sheet, but qualitative overlay could be used to account for management actions
Outputs	Aggregate measures of financial stability risks and qualitative information on responses	Firm-specific quantitative and qualitative outputs; cross-bank benchmarking can be informative	Firm-specific balance sheet and regulatory variables, and qualitative information
Supervisory Applications	Macroprudential risk identification and monitoring, awareness raising	Qualitative supervisory engagement (e.g., part of Pillar 2 supervisory review)	Qualitative supervisory engagement (e.g., part of Pillar 2 supervisory review)
Regulatory Applications	Regulatory applications not appropriate due to analytical scope and high level of uncertainty	Bank-specific applications not appropriate. Potential relevance to assessment of prudential framework	No near-term applications. Potential future input to capital planning if important preconditions met.

Figure Notes: (*) refers to shorthand labels for the NGFS Phase II Climate Scenarios. NZ50 = Net Zero 2050 (1.5°C), NDC = Nationally Determined Contributions, CP = Current Policies, DNZ = Divergent Net Zero, DT = Delayed Transition, B2C = Below 2°C.

The Reference Approaches are differentiated by three key foundational elements – climate risk horizons; objectives and analytical questions; and tools – which together should shape the focus and analytical orientation of an exercise. Following from these elements, the Reference Approaches provide indicative guidance on different design choices which can serve as a series of blueprints to ensure exercise design is in keeping with the analytical objectives and intended application of results (see Section 3.3):

- 1. Long-term Macroprudential Horizon Scanning:** Many supervisory SCRMs exercises to date have been oriented towards a **2050** climate risk horizon, with a view to assessing the potential impacts on the financial system and broader macroeconomy of a system-wide shift towards Net Zero, or the potential costs if global temperatures rise significantly above 2°C of warming by 2100. This Reference Approach reflects this type of long risk time-horizon exercise.

- 2. Medium-term Firm-level Assessment:** Looking forward on the path to Net Zero by 2050, the next key transition milestone facing the global economy is to achieve a 50% reduction in CO₂ emissions relative to 2010 levels by **2030**. This Reference Approach is focused on the assessment of the dynamics of the transition over the medium-term. Firms and supervisors can both benefit from a better understanding of how the dynamics of different disorderly transition pathways could impact individual institutions, and what potential financial stability risks could arise. As some physical risks will increase over coming decades, but many chronic impacts will not manifest fully until later in the century (e.g., sea level rise), this reference approach focuses more on transition risks while recognizing that physical risks may exacerbate transition-related disruptions in certain sectors or jurisdictions.
- 3. Stress Testing Climate Risk Drivers:** Of the three, this Reference Approach is most similar to mainstream macro-financial stress testing, with the aim of assessing the potential impacts of climate risks on the safety and soundness of financial institutions over the near-term financial resilience and business planning horizon of approximately 1 to 5 years. Unlike the first two, this Reference Approach employs the use of stress testing tools rather than scenario analysis.

At present, there is not a common international approach or set of principles to guide supervisors' choices on the potential applications of the results of SCRM exercises—in particular their relationship to the prudential framework. The results of supervisory SCRM exercises could potentially be applied in number of ways; it is important that such applications reflect the high levels of uncertainty inherent in forward-looking analysis, the medium- to long-term nature of most climate risks, and the interrelated and contingent nature of climate risks and socioeconomic responses to them, as well as acknowledging the current levels of maturity of analytical approaches. In the case of supervisory SCRM exercises conducted by banking prudential authorities, we recommend that the Basel Committee on Banking Supervision (BCBS) could develop an initial set of Global Principles and/or Sound Practices for climate scenario analysis and stress testing to help align emerging supervisory approaches across jurisdictions.

The results of medium- or long-term climate scenario analysis exercises should be treated with caution and should not inform capital evaluations, particularly as there are more efficient tools available to incentivize and oversee banks' management of longer dated risks. There are conceptual issues with setting capital requirements – which are intended to be a cushion against unexpected losses that could occur in the near-term – for risks that could materialize in 10, 20 or even 50 years. In addition, the simplifying assumptions and degree of uncertainty in long-term scenario analysis makes such exercises generally indicative of risks, rather than sufficiently robust to inform prudential requirements for individual institutions. Finally, the introduction of near-term capital implications for potential medium- to long-term risks could potentially have a counterproductive impact on the goal of an orderly transition to Net Zero with minimal risks to financial stability, for example, by disincentivizing flows of transition finance to high-carbon sectors. Nevertheless, climate scenario analysis is a powerful tool for medium and longer-term risk assessment, such as horizon scanning,

identification of risk transmission channels, and exploration of the impact of alternative transition and physical risk scenarios on financial stability.

While near-term climate stress testing could conceptually serve as an input to capital adequacy assessment, we believe it would currently not be appropriate to do so as the foundations are not in place with respect to knowledge, data and modelling. As recognized by the Basel Committee on Banking Supervision (BCBS), caution is required when using climate stress testing to assess resilience³. Several conditions, which are unlikely to be met in next few years, would need to be met before climate stress tests could be informative to quantitative capital planning (see Section 3.2).

Cross-jurisdictional alignment and collaborative development of SCSA exercises should be a near-term priority for prudential authorities, aided by the global standard setting bodies (see Section 4). Greater cross-jurisdictional alignment would deliver a triple win: it would bring greater consistency to the results of exercises; support the development of common approaches to key modelling and data elements; and drive greater prioritization of investments by participating financial institutions (see Section 4).

In the near term (next 1 to 2 years), we recommend the following actions:

1. The BCBS could develop an initial set of Global Principles and/or Sound Practices for climate scenario analysis and stress testing.
2. Supervisors could discuss the findings of SCRM analysis in supervisory colleges. The BCBS could support national authorities and supervisory colleges by gathering information about planned supervisory exercises.
3. National prudential authorities should apply the NGFS Reference Scenarios in supervisory exercises, and financial institutions should refer to them as part of their internal scenario analysis exercises.
4. Continued and expanded development of pre-competitive industry collaboration, and public-private collaboration, to address data gaps.
5. Collaborative work to explore emerging aspects of SCRM practice and identify leading approaches.

In the medium term (next 2 to 5 years), we recommend the following actions:

1. The Financial Stability Board (FSB) could develop its capacity for cross-sectoral and cross-jurisdictional climate risk horizon scanning.
2. In future, there may be a role for coordinated cross-jurisdictional SCRM exercises, for example as undertaken by the BCBS for the banking sector.

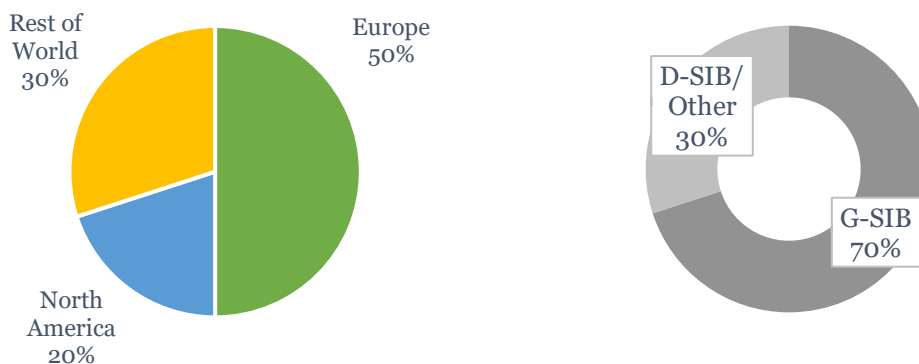
³ For example: *“Climate stress testing evaluates the effects of severe but plausible climate scenarios on the resiliency of financial institutions or systems. However, the uncertainty inherent in longer-dated assessments ... and the limited predictive power of historical observations to describe future climate-economic relationships ... render estimates of capital shortfall (or other measures of resiliency) less reliable than those of conventional stress tests employed by supervisors and banks to evaluate resiliency.”* Basel Committee on Banking Supervision, [“Climate-related financial risks - measurement methodologies,”](#) April 2021. Hereafter referred to as “BCBS 2021 (April).”

Report Overview

The objective of this report is to share industry perspectives on Scenario-based Climate Risk Measurement (hereafter “SCRM”) analyses which are increasingly being undertaken by prudential authorities (also referred to as “supervisors” in the report) and banking institutions across the world. The report includes analysis and proposes recommendations for supervisors and the banking industry on ways to enhance decision-usefulness, efficiency, and alignment with respect to SCRM exercises, and recommendations for further collaborative options to develop approaches in the coming years. The IIF report is intended to be an input and complement to work being undertaken by public sector authorities and global standard setting bodies on this important topic.

As input to this report, in 2021 H1 the IIF has consulted closely and gathered data from a group of 20 large IIF member banks from different jurisdictions - see Figure 1 for summary information about the sample of project participating banks.⁴ Participating banks provided input via a written survey, bilateral meetings with IIF staff and in a series of three cross-bank workshops. Where specific information relates to this sample of banks, that is stated in the report. That said, the IIF has also consulted its broader global membership for feedback on the report and recommendations herein, which are intended to provide representative global industry views at the time of writing.

Figure 1: Headquarter location and systemic importance of the 20 project participating banks
20 large banks surveyed globally, more consulted via IIF membership engagement



⁴ The 20 project participating banks include the following institutions: ABN AMRO Bank, Barclays, Bank of Montreal, BNP Paribas, Citibank, Credit Suisse, DBS Bank, Deutsche Bank, HSBC, ING, Investec, Itaú Unibanco, J.P. Morgan, Mizuho Financial Group., MUFG Bank, Ltd., Santander, Société Générale, Sumitomo Mitsui Trust Holdings, and UBS. The messages in this report reflect views of the IIF authors and are informed by engagement with the broader IIF membership, they do not necessarily reflect the views of any of aforementioned banking institutions.

The report proceeds as follows:

- 1.Role and Context for Scenario-based Climate Risk Measurement..... 9
- 1.1 SCRM Approaches: Climate Scenario Analysis vs. Climate Stress Testing..... 9
- 1.2 Industry and Supervisory SCRM Practices..... 10
- Box 1: How are banks using forward-looking risk management approaches for climate-related risks?... 14*
- 2.Supervisory SCRM Exercises to Date: What Are We Learning? 17
- 2.1 Unlocking the benefits of supervisory SCRM exercises..... 18
- Box 2: Select Examples of Success Areas in Supervisory SCRM Exercises to Date 18*
- 2.2 The Importance of Addressing Fragmentation in Supervisory SCRM Approaches20
- 2.3 Insights from the results of pilot SCRM exercises to date.....21
- 3.A Framework for Alignment: Reference Approaches for SCRM Exercises25
- 3.1 Foundational Elements.....25
- 3.2 Key Design Choices within an SCRM Exercise30
- Scenarios30
- Box 3: Industry Feedback on NGFS Reference Scenarios33*
- Scope35
- Format and Specification37
- Modelling Assumptions.....39
- Outputs.....41
- Application of Results42
- 3.3 Three Proposed Reference Approaches44
- 4.Recommended Actions for Cross-jurisdictional Alignment and Development.....53

1. Role and Context for Scenario-based Climate Risk Measurement

1.1 SCRM Approaches: Climate Scenario Analysis vs. Climate Stress Testing

Approaches to supervisory SCRM exercises can be differentiated into two main “buckets”: climate scenario analysis and stress testing. While scenario analysis and stress testing approaches have things in common - e.g., they are both forward-looking and involve the use of scenarios to estimate financial impacts - there are important differences between the two tools, which affect their uses, design and potential relevance in a prudential context.

The BCBS has distinguished scenario analysis from stress testing on the basis of scope, relevance across climate risk time horizons, and potential applications by firms and supervisors. In its April 2021 analytical report on “Measurement Methodologies,”⁵ the BCBS differentiates forward-looking climate risk assessment approaches (involving the use of scenarios) into three main groups of tools for risk quantification - scenario analysis, stress testing, and sensitivity analysis - with the latter two considered as subsets of the first (see Figure 2). The BCBS further distinguishes climate scenario-related risk measurement from macroeconomic stress testing because of its scope, time frame, and use of results.⁶

In this report, we draw on the BCBS definition and delineation of “climate scenario analysis” and “climate stress testing” as a foundational distinction in later sections. We will focus on climate scenario analysis and climate stress testing as two distinct categories of tool for SCRM analysis; we consider it important to make a formal delineation between the two, which are sometimes referred to interchangeably in policy debates and literature.⁷ We will also make a distinction between “supervisory SCRM” exercises and other “voluntary” or “internal” SCRM exercises, where the former is an exercise that is initiated by prudential authorities and banks are required or requested to participate⁸. In the case of supervisory SCRM exercises, these can either be “supervisor-conducted” (the analytics are undertaken by the supervisory authority) or “firm-conducted” (financial institutions are asked to conduct the analytics and return results to the prudential authority).

Figure 2: BCBS Definitions of Alternative Climate Risk Quantification Approaches	
Scenario Analysis	<p>“Climate scenario analysis is a forward-looking projection of risk outcomes that is typically conducted in four steps: (1) Identify physical and transition risk scenarios; (2) Link the impacts of scenarios to financial risks; (3) Assess counterparty and/or sector sensitivities to those risks; and (4) Extrapolate the impacts of those sensitivities to calculate an aggregate measure of exposure and potential losses. Scenario analysis can be conducted at different levels of granularity to identify impacts on individual exposures or on portfolios. By examining the effects of a wide</p>

⁵ BCBS 2021 (April).
⁶ See BCBS 2021 (April), Table 1.
⁷ Sensitivity analysis is methodology to explore the range of potential impacts and uncertainty associated with scenario-based outputs, which can be applied as a methodological process in either scenario analysis or stress testing exercises, or as a simpler “partial” approach to assessing the effect of a key variable of interest.
⁸ An exercise is referred to as a supervisory SCRM exercise even if banks are asked to participate on a voluntary basis, as is the case in some of the pilot exercises undertaken by supervisors to date.

	range of plausible scenarios, scenario analysis can also assist in quantifying tail risks and can clarify the uncertainties inherent to climate-related risks. For the purposes of climate-related risks, scenario analyses tend to be longer-term in scope and used to evaluate the potential implications of climate risk drivers on financial exposures.”
Stress Testing	“Stress testing is a specific subset of scenario analysis, typically used to evaluate a financial institution’s near-term resiliency to economic shocks, often through a capital adequacy target. ... Recently, stress testing has been extended by some banks and supervisors to include climate-related risks and scenarios. Climate stress testing evaluates the effects of severe but plausible climate scenarios on the resiliency of financial institutions or systems. However, the uncertainty inherent in longer-dated assessments ... and the limited predictive power of historical observations to describe future climate-economic relationships ... render estimates of capital shortfall (or other measures of resiliency) less reliable than those of conventional stress tests employed by supervisors and banks to evaluate resiliency.”
Source: Extracts from BCBS 2021 (April), pages 17-18.	

1.2 Industry and Supervisory SCRMs Practices

An increasing number of supervisors across the world have taken steps to develop and pilot different types of exploratory scenario analysis exercises to assess the impact on the financial system of physical and/or transition risks stemming from climate change. As of July 2021, authorities in at least 18 national jurisdictions and the European Union have conducted, or announced an intention to conduct, an SCRMs exercise involving banking institutions, amounting to a total of at least 26 exercises (see the timeline graphic in Figure 3). Supervisory-led scenario analysis exercises to date have varied significantly in terms of objectives, approaches, time horizons, firms and risks in scope. Underlying design parameters and approaches have significant implications for the feasibility, outputs and ultimately the value of scenario analysis exercises, for both supervisors and firms.

At the same time, many banks across the world are now voluntarily conducting climate scenario analysis for purposes of internal risk management, as input to disclosures (e.g., using the TCFD framework), and to inform strategic decision making - such as setting climate-related targets and commitments (see Box 1). Practices vary widely across banks, and many are still in the preparatory stages to run internal quantitative exercises; there is also natural heterogeneity in approaches depending on the institution’s business model and geographic footprint and, therefore, exposure to specific climate risks. Banks’ strategic responses to climate-related risks can involve changes to internal governance and risk management to ensure that future climate-related shocks and trends are factored into current planning and decision making. Many banks also produce and report disclosures to their external stakeholders for transparency and accountability regarding climate risks and opportunities, including TCFD-aligned disclosures and those aligned with other voluntary or mandatory frameworks.⁹ Increasingly, banks are setting explicit commercial targets linked to

⁹ Voluntary disclosure of information on ESG issues has long taken place via frameworks such as the Sustainability Accounting Standards Board (SASB) and the Global Reporting Initiative (GRI). More recently, the Task Force on Climate-related Financial Disclosures (TCFD) has proven to be a workable

time-bound climate performance outcomes, such as Science-Based Targets or Net Zero Commitments.¹⁰ By making these forward-looking commitments, banks are internalizing the longer risk time horizon associated with climate change and reflecting it in strategic decision-making today. However, this requires the collection and analysis of new types of decision-useful information, for example on clients' mitigation, adaptation and transition plans to assess potential transition risks to the bank, and methodologies to integrate this information into forward-looking analysis.

Ideally, supervisory SCRM exercises would be positioned as complementary to, and a catalyst for, banks' own internal analysis. Industry and supervisory goals are ultimately aligned: to enhance risk management practices and build capabilities to influence better strategic thinking on climate risk management. In addition to their own internal analysis, many banks are optimistic that supervisory SCRM exercises have the potential to be a decision-useful input to their internal scenario analysis, risk management and strategic planning if designed and executed optimally.

It is critical that supervisory SCRM exercises do not "crowd out" banks' internal analysis and capacity building efforts. While important for shaping a shared view across industry and supervisory communities on the potential implications of future climate risks, very frequent, highly granular or overlapping supervisory exercises may constrain capacity for firms to develop their own capabilities and approaches. Supervisory demands for SCRM exercises on top of firms' own internal analysis should be proportionate. This is not currently the case for cross-border banks, which are coming under pressure to engage (formally or informally) with multiple, varying exercises across jurisdictions within overlapping and ambitious timeframes. This type of demand puts a strain on the scarce resources within a bank's scenario analysis, climate/ESG risk and other risk functions.

Supervisory SCRM exercises should be driven by an authority's prudential mandate, with transparency around how the results are applied. As discussed in IIF (2021) *Prudential Pathways*, there is value in greater clarity around why authorities are undertaking SCRM exercises and how the outputs will be used, including any prudential applications. Notwithstanding the potential benefits from SCRM exercises, some supervisory objectives may be met through the use of other tools beyond supervisory SCRM exercises, including supervisory assessment of firms' own forward-looking analysis and disclosures of forward-looking metrics.

So far, most supervisors have been cautious in exploring potential prudential applications of supervisory SCRM exercises, but the debate on when and how it may be appropriate to use the results of SCRM exercises is advancing rapidly. The BCBS cautioned about the reliability of climate stress testing in this regard, recognizing a range of methodological issues, including limited historical observations about financial impacts of

and widely accepted framework to report on climate-related risks and opportunities. The TCFD framework now has support from over 1,500 organizations, of which over 700 are financial institutions responsible for assets of \$150 trillion (TCFD, "[2020 Status Report](#)," October 2021).

¹⁰ For example, see IIF, "[Green Weekly Insight: Navigating Net Zero](#)," April 29, 2021.

climate-related risks.¹¹ In their April 2021 report the BCBS observe that: *“In the end, the results of climate-change-related scenario exercises may challenge the traditional supervisory use of scenario analysis in a stress testing capacity, eg informing capital requirements. Such exercises may rather inform the strategic and business model resilience of institutions, thereby underscoring the need to evaluate the appropriateness of individual supervisory tools for various time horizons.”*¹² In its June 2021 Climate Biennial Exploratory Scenario exercise, the Bank of England explicitly stated that the exercise will not be used to set capital requirements.¹³ The ECB has said the same about its planned 2022 climate stress test, but has telegraphed an intention to ultimately use the results of such exercises to reflect risks in *“all relevant supervisory requirements”* including Pillar 2 capital requirements.¹⁴

There is currently an opportunity for supervisors and industry to work together to make SCRM exercises more decision-useful for both firms and supervisors, and reduce the risk of fragmentation across jurisdictions. In the absence of a common international approach to the design and execution of SCRM exercises, there is a risk of economically costly fragmentation - similar to the experience with macroeconomic stress testing after the global financial crisis. The resulting fragmentation reduced comparability of different jurisdictional exercises (e.g., in the EU SSM, UK and U.S.), increased complexity for supervisors and banks, and reduced efficiency for global firms facing multiple different exercises. Alignment between authorities on SCRM approaches would help maintain focus and allow quicker and more targeted research and development in the industry, and could support discussion in supervisory colleges for cross-border banks.

The increasing uptake of ‘Net Zero’ goals by financial institutions, corporates, and governments is creating a new imperative to clarify the relationship between the supervisory agenda on climate change risk and industry initiatives on climate alignment. Net Zero commitments could theoretically provide a measure of an institution’s exposure to long-term risks and a source of information about institutions’ reaction functions over a given transition pathway. However, considering that metrics and frameworks for Net Zero alignment (and other similar commitments, such as science-based targets) are still evolving, further industry innovation will be necessary to ensure the development of suitable mechanisms for accountability. It will be important for supervisors to work with industry to consider how best industry initiatives could be appropriately reflected within SCRM exercises, without losing sight of the important differences between market-driven alignment commitments and risk management.

¹¹ BCBS 2021 (April).

¹² Ibid. Page 41.

¹³ Bank of England, June 8 [News Release](#): “The CBES is an exploratory exercise. It will not be used by the Bank to set capital requirements. Instead, participants’ submissions may inform the Financial Policy Committee’s future approach to system-wide policy issues, and the Prudential Regulation Authority’s (PRA) future supervisory approach.”

¹⁴ Frank Elderson (ECB), [“Patchy data is a good start: from Kuznets and Clark to supervisors and climate.”](#) June 16, 2021.

In the following sections, we summarize industry perspectives on the lessons learned from supervisory SCRM exercises to date, and propose recommendations to support greater alignment and more efficient advancement in the years to come.

Figure 3: Charting Supervisory Climate Scenario Analysis Exercises over time

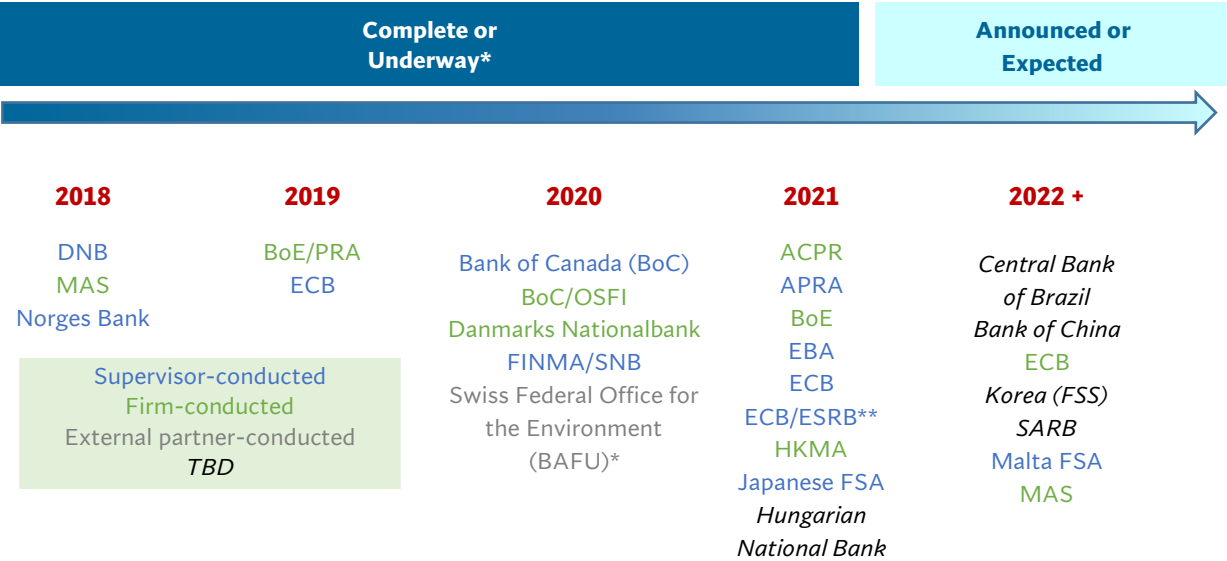


Figure notes: Several exercises are conducted across more than one calendar year. Where exercise results have been published, the year shown is the year in which results were published; where exercises are not yet final or results are not yet published, the date shown is when the exercise started. Some exercises included non-banks in addition to banks. Based on public data and member input. [ECB/ESRB 2021 \(July\)](#) includes a detailed summary of several of the exercises shown here.

*The Swiss Federal Office for the Environment (BAFU) is not a bank prudential authority but undertook a voluntary scenario analysis exercise that involved 179 Swiss financial institutions.

** ECB/ESRB Project Team on climate risk monitoring using data from the EBA 2021 pilot exercise and parameters from the forthcoming ECB top-down exercise.

Box 1: How are banks using forward-looking risk management approaches for climate-related risks?

Several banks, including the majority of banks we surveyed in this project, noted that they are already voluntarily engaging with climate scenario analysis for purposes of internal risk management, input to the strategy component of their TCFD disclosures, and to inform corporate decision making (such as setting climate-related targets and commitments).

Figure B1.1 shows the main challenges with respect to scenario-based climate risk measurement as reported by the project participating banks. Data availability; model selection or adaptation; and analysis over potentially very long time horizons under a number of possible scenarios present significant technical challenges. Some banks are engaged in collaborative industry or public/private initiatives to overcome some of these challenges; one example is the [OS-Climate](#) initiative to develop a global data compendium, data commons and scenario-based analytics within an open-source platform. It is important that any supervisory SCRM exercises are complementary to banks' voluntary internal analysis, and do not "crowd out" industry-led development.

Figure B1.1: What are the main challenges at present to modelling financial risks under different climate scenarios?

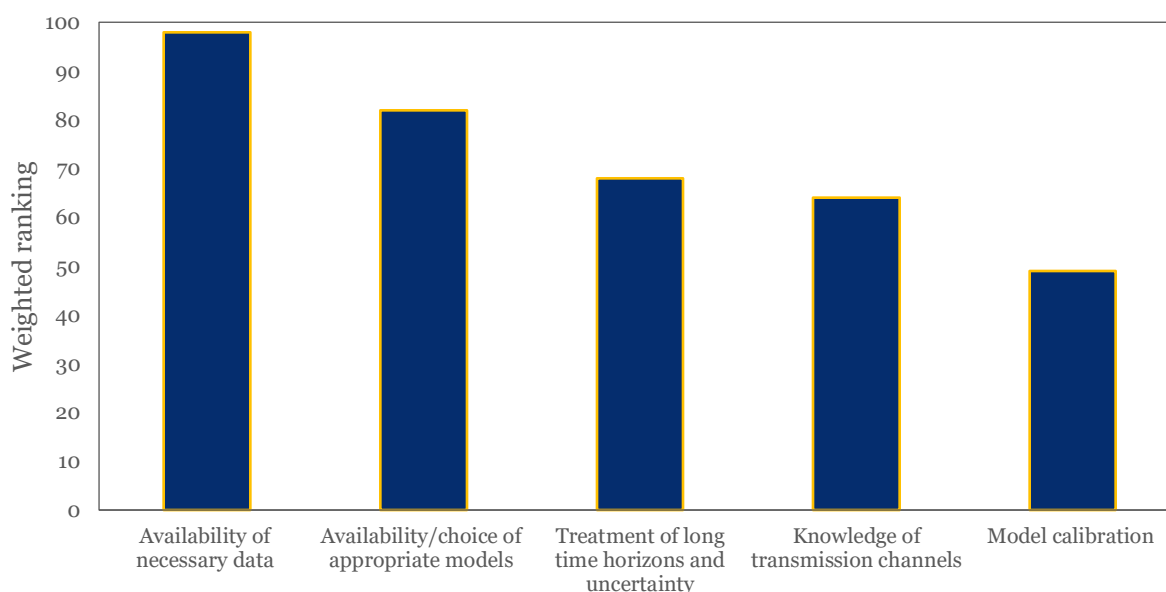


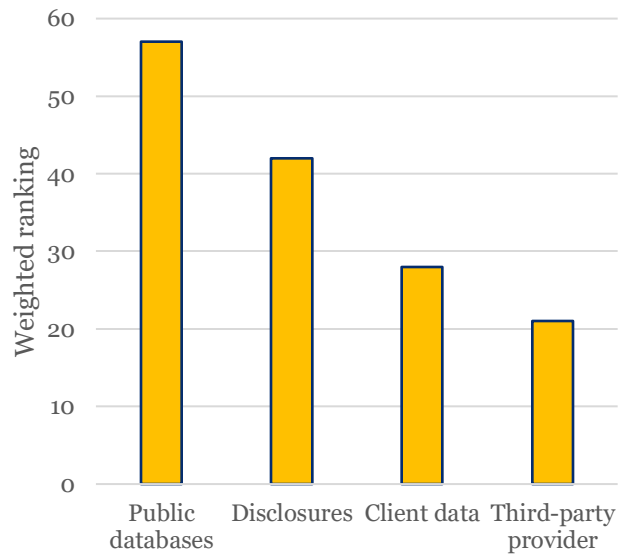
Figure notes: Chart represents aggregate views of greatest challenges to modelling financial risks under different climate scenarios based on views in sample of 20 project participating banks. Banks were asked to rank options; figure shows a sample aggregation of the rankings.

- **Skills/Resources:** Internal organizational changes are often required given the unique nature of climate scenario analysis. For example, arranging a multidisciplinary team from across the bank. This is resource intensive, and draws on the same expertise in the bank that is working on general climate risk analysis and strategy, as well as macro-financial modelling experts. Supervisory SCRM exercises would draw on the same expertise within banks as their internal exercises.

- Scenarios:** Many banks are starting to refer to the NGFS Reference Scenarios in their own scenario analysis (40% of the 20 project participating banks, and 46% in a wider sample of a sample of 28 IIF member financial institutions). These are often a baseline for a broader set of scenarios that financial institutions investigate, chosen for their relevance to the institution’s business model and balance sheet. For example, some banks are using bespoke scenarios to focus on physical risks in their main geographic locations. Some banks are using internally-developed scenarios, and others are referring to external scenarios such as the International Energy Association (IEA) or Intergovernmental Panel on Climate Change (IPCC). Some firms have found that it was easier to discuss results of climate scenario analysis exercises internally with senior management if physical risks and transition risks are captured distinctly (although, in reality, they are ultimately related over the long term), as it becomes easier to conceptualize the scenario and consider responses.

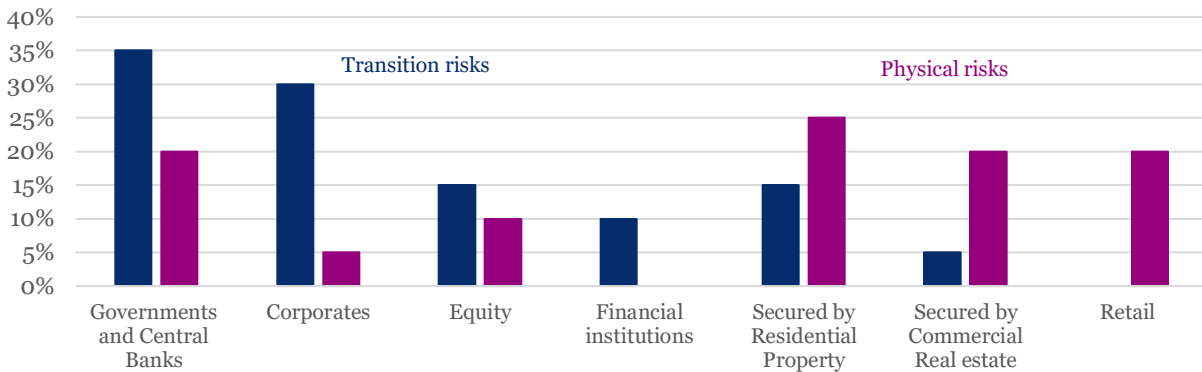
- Data:** Lack of the necessary data was the biggest reported challenge by the global sample of project participating banks (see Figure B1.1). Responses on data availability varied significantly across all risk types and exposure types; however, the majority of banks reported poor data in every case (see Figure B1.3). Data availability significantly differs with regard to exposure type, with some data for corporates being reported primarily for transition risks while some data for retail exposures is only available for physical risks. The nature of SCRM, in particular the transition risk data requirements, is requiring banks to

Figure B1.2: Primary data sources across all exposures and risks



make direct additional data requests from their counterparties (e.g. emissions, geolocation data) in a way that is more intrusive and demanding than in traditional macro-financial stress testing exercises. In most cases, banks used data from public databases; disclosures are the second most used data source, which shows the importance of efforts to improve both (see Figure B1.2). Banks are highly reliant on data proxies at present, leading to questions about best proxies and ways to standardize proxy techniques, which are particularly important for comparability of results in supervisory exercises.

Figure B1.3: Proportion of project participating banks reporting 'Good' data for physical/transition risks by exposure type



- Modelling:** Banks are currently experimenting with a variety of approaches to modelling the financial impacts of climate change and there is no leading approach yet. Some banks are developing or adapting their in-house models, but many are using approaches acquired from outside the bank. Some of the banks surveyed are using one or more of: sector-level modelling; counterparty-level modelling; adaptation of existing credit risk models; tools for network analysis based on exposure to climate-sensitive sectors; approaches for assessing their alignment with the Paris Agreement. In addition, there are challenges with model calibration in the absence of a common understanding about the relationship of key macro-financial variables under different climate scenarios. Back-testing or validation of models used for SCRMs presents unique challenges, particularly given that historical time series are generally less informative with respect to certain climate-related risks such as transition risk. This also makes it more complex to calculate model or parameter uncertainty.

2. Supervisory SCRM Exercises to Date: What Are We Learning?

For this report, the IIF worked closely with 20 large banks from across the world to take stock of their experiences with supervisory, as well as internal, SCRM exercises. Figure 4 summarizes the experience of this sample of 20 banks' experience with, and expectations for, supervisory SCRM exercises. The majority (85%) of banks in the group have already engaged in or are preparing for specific planned supervisory exercises. 75% of the group have experience with supervisory exercises that have taken place or are currently underway. Figure 5 shows the jurisdictional exercises with which project participating banks have experience.

Figure 4: Snapshot of 20 major banks' experience and expectations with supervisory SCRM exercises

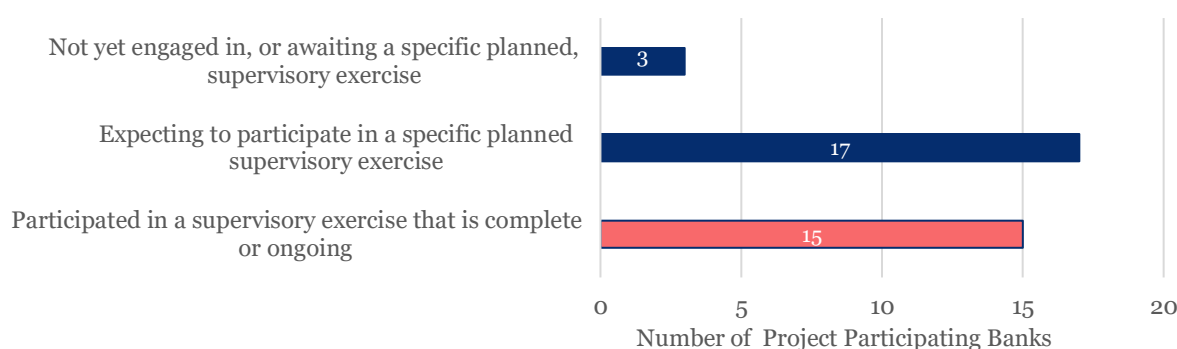


Figure notes: 15 of the banks that have participated in a supervisory SCRM exercise also expect to participate in another specific planned exercise, which contributes to the 17 banks shown in the second bar.

Figure 5: Supervisory SCRM experiences of project participating banks



Project participating banks have first-hand experience with the following Supervisory Exercises¹⁵:

- [DNB \(2018\)](#)
- [FINMA & SNB pilot \(2020\)](#)
- [Swiss BAFU \(2020\)](#)
- [ACPR \(2021\)](#)
- [BoE \(2021\)](#)
- [EBA pilot \(2021\)](#)
- **HKMA**
- **JFSA**
- **ECB (2022)**
- **SARB**

Green shading: Jurisdictions with which project participating banks have experiences with SCRM exercises, including planned or forthcoming exercises. World map generated with mapchart.net

¹⁵ Where a date is not shown, the supervisory exercise is still under discussion or being planned. These short-hand references to exercises will be used throughout the report.

2.1 Unlocking the benefits of supervisory SCRMs exercises

Supervisory SCRMs exercises to date have varied considerably in terms of scope and approach. There has been a mix of supervisor-conducted and firm-conducted exercises. The exercises shown in Figure 5 have all been highly quantitative, but the balance sheet scope of the exercises has varied a lot: for example, some banks have found less than 20% of their balance sheet in scope of an exercise, while others have found a much higher proportion of their balance

sheet in scope. In terms of portfolios, corporate, retail and real estate-secured portfolios have commonly been in scope of exercises to date.

In general, those banks that have participated in a supervisory exercise believe it has unlocked benefits for their firm. Given the current challenges associated with data, knowledge and modelling capabilities, many banks believe that supervisory exercises can add most value at this time if they shed light on and help address challenges such as data gaps. Several banks found that the supervisory exercise helped them to identify potential sources of risk, and generally contributed to internal knowledge and capacity building. Supervisory exercises have helped to identify specific data or knowledge gaps, and have been a springboard for banks' internal analysis and SCRMs exercises. Some banks remarked that the supervisory impetus for an exercise was useful for securing engagement across the business on the exercise and its results. It has also spurred increased engagement with banks' counterparties to gather data about their exposure to climate-related risks and any adaptation plans.

SCRMs is still a challenging task and a nascent field of analysis within the mainstream financial industry - supervisors can adopt approaches that can foster capacity development, inform banks' strategic thinking, and facilitate participation (see Box 2). There are organizational aspects that can benefit the feasibility of an exercise and the efficiency of the overall process, such as early consultation and continued engagement with the industry and participating banks. In addition, it is extremely helpful if supervisors provide certainty by clarifying early on which institutions will be in scope of an exercise.

During the current developmental phase for SCRMs approaches, **there are practical and conceptual benefits to differentiating supervisory SCRMs exercises from other prudential activities, including macro-financial stress testing.** Supervisors could draw on the "regulatory sandbox" approach that was taken to enable supervisory oversight of the

Box 2: Select Examples of Success Areas in Supervisory SCRMs Exercises to Date

Early and open engagement:

Consultation on exercise design (ACPR 2021, BoE 2021)
Q+A processes to address banks' questions (ACPR 2021)

Standardization:

Use of standardized templates,
Clear expectations/guidelines, Use of NGFS scenarios
(BoE 2021)

Access to data and tools:

Exposure to a range of methodologies/third-party tools,
datasets, etc. (DNB 2018, BAFU 2020)

Peer insights:

Sharing/benchmarking results, which can provide
insights to individual participants
(DNB 2018, BAFU 2020, ACPR 2021)

experimentation and piloting of emerging digital finance products and services. For example, this could entail a different approach to data quality and model validation expectations, which would reduce the operational complexity for participating financial institutions and permit a greater emphasis on collaborative efforts to overcome obstacles to informative SCRM analysis. As discussed in Section 3.3, there are other advantages to conducting supervisory SCRM exercises in a “regulatory sandbox” environment until data, tools and understanding have improved to the point at which results are meaningful and comparable across firms.

To the extent that supervisory SCRM exercises are undertaken, they are most useful when they are thoughtfully designed and executed consistently across participating institutions. Setting out clear guidelines for an exercise and referring where possible to the established NGFS Reference Scenarios can be helpful in this regard. Some supervisors have leveraged the Phase I Reference Scenarios in exercises since their release in 2020; greater alignment on other design choices pertaining to the implementation of scenarios can be helpful (see Section 3, including Box 3). Further, it is important that technical elements of scenarios, such as key variables, are provided by the authority running the exercise. Similarly, if the supervisor is able to provide access to necessary data that the participating banks would otherwise need to acquire directly (e.g. from third-party providers) this lowers barriers to participation and levels the playing field among participating banks. In some cases, it could be appropriate for the supervisory authority to specify a model or provide a modelling tool for purposes of comparability, although there is value in diversity of practice and model exploration at this early phase of development as well as in finding ways for individual banks to adapt and integrate with their existing modelling architecture. The specification of common models or parameters by supervisory authorities for SCRM exercises could still be useful for purposes of benchmarking and maximum comparability, as a baseline for banks’ own modelling estimates, or if internal climate risk modelling capabilities are underdeveloped in a jurisdiction.

Banks have found it particularly valuable when supervisors have shared with participating institutions information about best practices, common approaches and cross-firm insights in the results. A specific benefit of supervisory SCRM exercises derives from the fact that the same exercise is performed on multiple banks. This can generate peer benchmarks and insights for supervisors, and also for individual participating banks. Aggregate quantitative data, as well as qualitative information shared by the supervisor, can be used in this regard. In general, greater transparency of the results should be expected among participating financial institutions compared to what is ultimately disclosed more widely by the supervisor. Nevertheless, publishing sufficiently aggregated results of supervisory SCRM exercises can raise awareness around emerging trends, risks and opportunities. Given the uncertainty and level of judgement involved in these exercises, and potential sensitivity of market participants and other observers to the results, it would be premature to release institution-specific results on potential risk exposures.¹⁶ It is helpful if banks are able to engage with exercise results prior to any broader public disclosure of aggregate results.

¹⁶ IIF, [“Prudential Pathways: Industry Perspectives on Supervisory and Regulatory Approaches to Climate-Related and Environmental Risks,”](#) January 21, 2021.

2.2 The Importance of Addressing Fragmentation in Supervisory SCRM Approaches

While supervisory SCRM exercises to date have generally focused on the major firms headquartered in a particular jurisdiction, an increasing number of banks with cross-border operations are being expected to participate in more than one jurisdictional exercise. For example, a bank that is supervised by the EU Single Supervisory Mechanism (SSM) would be expected to participate in European Central Bank (ECB) exercises and national exercises, for example by the domestic French supervisor (the Autorité de Contrôle Prudentiel, ACPR); similarly, international banks active in Hong Kong may be subject to an exercise run by the Hong Kong Monetary Authority (HKMA) as well as by their consolidated supervisor.

Fragmentation in supervisory approaches to SCRM exercises may pose challenges to banks' abilities to develop globally consistent frameworks and strain industry capacity and resources during a phase of development and innovation. Divergent approaches also may impair efforts to robustly monitor risks to financial stability and build awareness. There are three types of issue that can occur: balance sheet fragmentation for cross-border financial institutions; operational fragmentation; and reduced clarity and comparability of results.

- Balance sheet fragmentation: Banks (and other financial institutions) make strategic plans and commitments, including in relation to their climate strategy, at the level of the consolidated group. For cross-border banks with supervisors in different jurisdictions, it is disruptive if supervisors engage in different SCRM exercises and make links to local capital requirements and capital planning. For an allocatively efficient transition, it is helpful if all supervisors have a clear understanding of the consolidated group strategy and the home authority's supervisory judgement of that strategy. In general, it is more efficient for exercises to be conducted at consolidated group level only and for the relevant findings to be shared with host supervisors within supervisory colleges. This approach would be consistent with the current BCBS *Stress Testing Principles*, which were developed for macro-financial stress testing¹⁷.
- Operational fragmentation: It may be suboptimal for financial institutions to allocate resources to conduct different exercises across subsections of their group and balance sheet. It puts pressure on scarce human resources within institutions which are required for other essential risk management functions, including internal SCRM analysis, which in turn contribute to financial stability. In addition, uncertainty about which financial institutions are in scope of a supervisory has a significant impact on the ability of firms to plan efficiently.
- Reduced clarity and comparability of exercise results: climate change and its potential impacts are a highly sensitive and complex issue. If authorities in different jurisdictions pursue fundamentally different approaches to SCRM exercises it will make it significantly more difficult for the supervisory community to interpret exercise results

¹⁷ See Principle 9: Stress testing practices should be communicated within and across jurisdictions. Basel Committee on Banking Supervision, "[Stress testing principles](#)," October 2018.

(for example, within a cross-border bank's college of supervisors)¹⁸, and for banks and authorities to explain the public results of exercises to stakeholders, including the investor community. At worst, it has the potential to undermine trust in financial stability, or the value of the exercises themselves. In the case of financial resilience stress testing, it has taken several years and iterations of exercises in different jurisdictions (such as the EU SSM, UK and U.S.) for banks and authorities to be able to explain the differences of approaches and the impact on the results. On a topic such as climate risks where the objective at this time is still to increase awareness and understanding, this sort of fragmented messaging could be extremely counterproductive.

2.3 Insights from the results of pilot SCRMs exercises to date

Supervisory SCRMs exercises completed to date, while varying in scope and approaches, have started to yield insights about the nature and potential materiality of climate-related financial risks for individual financial institutions, financial stability, and the broader macroeconomy. While the results of exercises are not directly comparable, it is worthwhile taking stock of some emerging themes and reflecting on the implications for current supervisory and bank actions, as well as areas of focus in future analysis.

In aggregate, the potential economic and financial costs of climate risk impacts over the short to medium term appear to be moderate and manageable from a financial stability perspective based on the available evidence to date. Supervisory exercises to date have revealed significant data gaps and modelling challenges, which makes impact estimation difficult. Notwithstanding these challenges, and the level of uncertainty in these assessments, a range of studies indicates that over the next approximately 5-10 years the financial stability risks are contained under disorderly transition and Hot house world scenarios; however, estimated potential future vulnerabilities can vary significantly across firms depending on their current balance sheets and business models. For example, looking at some key recent exercises:

- [DNB \(2018\)](#)¹⁹ examined four severe but plausible 5-year energy transition scenarios for the Netherlands and found that financial institutions' losses "*in the event of a disruptive energy transition could be sizeable, but also manageable.*" Results also showed a "*manageable*" impact on supervisory ratios. Across the financial industry, bank losses ranged between 1%-3% of total stressed assets, but were higher for insurers and pensions funds.²⁰
- [ACPR \(2021\)](#)²¹ found that French banks and insurers face "*moderate exposure*" to climate risks. French financial institutions have "*relatively low*" exposure to the sectors that will be most affected by transition risk. However, the ACPR observe that the "*the*

¹⁸ An analogy can be made to early bank recovery and resolution planning, when authorities were taking different approaches to the topic and made different requests of their supervised institutions which increased the complexity between authorities of discussions around cross-border institutions.

¹⁹ DNB, "[An energy transition risk stress test for the financial system of the Netherlands](#)," 2018.

²⁰ DNB (2018): 2-11% of stressed assets for insurers and 7-10% for pension funds.

²¹ ACPR, "[A first assessment of financial risks stemming from climate change: The main results of the 2020 climate pilot exercise](#)," 2021.

vulnerabilities associated with physical risk are far from negligible” under the IPCC scenarios used in their exercise.

- A [2020 ESRB](#)²² report found that the direct exposures of European financial institutions to carbon-intensive sectors are “limited and falling moderately on average,” thereby limiting potential losses from transition risk. The report emphasizes the importance of early action to reduce severe risks later, and that “*the costs to the economic or banking sector of even a sharp rise in carbon pricing or marked industrial shifts over a five-year timeframe are likely to be contained, and lower than for the potential losses due to physical risks resulting from climate change.*” Similarly, early insights from the [ECB’s](#) forthcoming top-down exercise²³ show that while extreme weather events “*greatly increase [companies] probability of default,*” there are strong advantages to acting early as the costs of damage in the case of inaction are far higher than the costs of transitioning in the exercise’s orderly scenario.
- A recently published detailed [ECB/ESRB \(2021\)](#)²⁴ report finds that “*credit and market risk could cumulate from a failure to effectively counteract global warming*”; the report notes however that credit risk losses under adverse 30-year climate scenarios are around half of the losses that could crystallize over much shorter horizons in conventional macroeconomic stress test exercises exploring severe non-climate-related risks. However, the ECB/ESRB warn of “*uneven vulnerability across EU regions, sectors and financial institutions*”.

However, these exercises also indicate the challenging ‘empirical tension’ stemming from climate risk horizons: while near-term risks may be low, near-term action is required to reduce the potential for significant risks manifesting in the future, both in terms of financial stability, but also broader macroeconomic costs. On one hand, these studies may seem reassuring, suggesting that supervisors and firms face contained risks over the near-term, considering the long-term nature of the low-carbon transition, and the potential for diversification away from especially risky sectors or geographies. But, on the other hand, the results are exemplary of the fact that the ‘tragedy of horizon’ remains an omnipresent challenge for supervisors and firms. The above-mentioned exercises point to the potential for significantly higher risks over the long-term, particularly under Hot house world scenarios, and to the economic and financial benefits of a timely implementation of effective climate policies.

This empirical tension raises important questions about the potential severity of future risks, and the most efficient near-term responses to address them. Supervisory and industry responses to the findings of SCRUM analysis should be proportionate and appropriate to the risks identified across time horizons, and degrees of certainty. In the face of long-dated risks, a myopic or ‘reflex’ response to potential future risks can undermine the objective of putting the economy and financial system on an orderly path to net-zero emissions. The first crop of exercises indicates that medium-term adaptation and mitigation actions by the banking industry will be highly important for achieving sustainable growth and maintaining financial

²² ESRB, “[Positively green: Measuring climate change risks to financial stability](#),” June 2020.

²³ Luis de Guindos (ECB), “[Shining a light on climate risks: the ECB’s economy-wide climate stress test](#),” March 18, 2021.

²⁴ ECB/ESRB, “[Climate-related risk and financial stability](#),” July 2021.

stability. The key question for firms and supervisors is, therefore, what types of actions are likely to be most appropriate and most efficient in terms of motivating an orderly transition.

Further attention on areas where risks are concentrated, or spillovers across the financial system may occur, would be beneficial in the coming years. While climate change is inherently characterized by high levels of uncertainty, SCRM analysis offers a way to begin sizing “known knowns”, and exploring potential “known unknowns,” including complex macro-financial risk transmission mechanisms. Specific issues to further investigate, as indicated by SCRM exercises to date, include deepening the understanding of the interplay between risks and responses within and between the banking and insurance systems, the need for more detailed analysis of the impact of physical risks, and the importance of transition financing for critical high-carbon sectors.

In addition, there are a number of open questions regarding the potential for greater visibility of potential future climate risks to result in negative unintended consequences for vulnerable communities and emerging market or developing economies. More granular analysis of potential climate risk impacts may affect investors’ and lenders’ perceptions of financial risks of these vulnerable counterparties, potentially leading to increases in their cost of capital. Such impacts have initially been examined in the sovereign debt sphere; researchers have concluded that climate vulnerability has already raised the average cost of debt in a sample of developing countries by 117 basis points²⁵. Similarly, developing nations often pay a high cost for financing for low-carbon and climate resilient technologies, and thereby face barriers to reducing potential physical and transition risks²⁶.

Recognizing the urgency of the climate crisis, it is crucial to consider how SCRM exercises can be most efficiently used to catalyze actions by banks, their clients, and supervisors that can reduce potential firm-specific and system-wide climate-related risks, and achieve the goal of an orderly transition to Net Zero. SCRM exercises can contribute to this goal by helping to size risks, informing transition strategies, and targeting supervisory engagement and oversight. To achieve this, supervisors and firms should work together to identify the set key analytical questions regarding future climate risks that need to be investigated now, and clarify how SCRM results can be appropriately leveraged to enhance awareness, create the right incentives, inform bank-client engagement and support better decision making.

Delivering on this objective requires greater alignment in how SCRM exercises are designed and conducted, and a common understanding of the role and limitations of forward-looking assessment in the context of the prudential supervisory and regulatory framework. It also requires a common understanding of the role of forward-looking assessment in the context of other prudential tools and broader financial sector and real economy policy instruments that will affect risk and alignment dynamics of the transition within the financial sector. Similarly, greater consistency in banks’ approaches to undertaking their

²⁵ UNEP, Imperial College, SOAS University of London (2018), “[Climate Change and the Cost of Capital in Developing Countries](#)”.

²⁶ University College London (2021), “[Higher cost of finance exacerbates a climate investment trap in developing economies](#)”.

own SCRM exercises can benefit the comparability of disclosures and contribute to awareness building within the financial industry.

In response to this need, Section 3 details a proposed framework of **Reference Approaches for Scenario-based Climate Risk Measurement** that can guide greater alignment among supervisors and the banking industry.

>> **Key Messages and Recommendations in Section 2**

- SCRM analysis has the potential to be a useful and versatile tool for banks; many large banks are already voluntarily engaging with it or preparing to run internal exercises. Banks that have already participated in a supervisory SCRM exercise believe it has unlocked benefits for their firm. Supervisors can adopt approaches that can foster capacity development, inform banks' strategic thinking, and facilitate participation, such as: early and open engagement; standardization where possible; provision of necessary data and tools or accommodation of data/methodological gaps; provision to participating institutions of best practices, common approaches and cross-firm insights in the results.
- During the current public-private development phase for SCRM, there are practical and conceptual benefits to differentiating supervisory SCRM exercises from other prudential activities, including macro-financial stress testing. For example, with a different approach to data quality and model validation expectations to reduce the operational complexity for participating financial institutions and permit a greater emphasis on collaborative efforts to overcome obstacles to informative SCRM analysis.
- Fragmentation in supervisory approaches to SCRM exercises may pose challenges to banks' abilities to develop globally consistent frameworks and strain industry capacity and resources during a phase of development and innovation, including on emerging topics such as Net Zero alignment. Divergent approaches also may impair efforts to robustly monitor risks to financial stability and build awareness.
- To avoid balance sheet, operational and communication-related fragmentation, it is preferable that home authorities only require financial institutions to participate in an SCRM exercise on a consolidated basis, and that these exercises should not be replicated on a local basis for subsidiaries. Ideally, all relevant information would be disclosed by the home supervisory authority to host authorities, consistent with the current BCBS *Stress Testing Principles*.
- Recognizing the urgency of the climate crisis, it is crucial to consider how SCRM exercises can be most efficiently used to catalyze actions by banks, their clients, and supervisors to reduce potential firm-specific and system-wide climate-related risks and achieve the goal of an orderly transition to Net Zero - including by sizing risks, informing transition strategies, and targeting supervisory engagement and oversight.

3. A Framework for Alignment: Reference Approaches for SCRM Exercises

SCRM exercises can vary significantly in terms of their research questions, their risk, market, and geographic scope, and the array of technical design choices and assumptions that shape how analysis is conducted. These design choices have significant implications for exercise feasibility, comparability of outputs and ultimately the value of the exercises for supervisors and firms. While the NGFS Reference Scenarios can help bring alignment for medium to long-term scenario analysis, a framework for broader SCRM alignment is needed.

To contribute to the alignment of SCRM exercise design choices with key research questions for supervisors and banks, the IIF and its members have developed a proposed set of three **“Reference Approaches” for Scenario-based Climate Risk Measurement.**

❖ *Reference Approaches provide a framework for aligning the key design choices inherent in SCRM exercises – the scenarios, scope, the format and specification, key modelling assumptions, outputs – with different microprudential, macroprudential, and strategic objectives and applications.*

The Reference Approaches are theoretical constructs that supervisors and firms may wish to apply to orient the design of exercises towards specific goals or analytical questions, and to reference in the implementation of exercises to help drive greater consistency in exercise design, implementation, and application.

The Reference Approaches are intended to be primarily relevant to the design of supervisory SCRM exercises, building from the NGFS Reference Scenarios. **They are also applicable to banks’ internal exercises,** and can be leveraged as a framework to explore different climate-related risks and alignment objectives at key intervals along future transition pathways.

Section 3.1 discusses the foundational elements shaping and differentiating the three Reference Approaches. Section 3.2 describes the implications of different design choices across six categories – scenarios, scope, format and specification, modelling assumptions, outputs, and application of results. Section 3.4 then describes the three proposed Reference Approaches in detail, summarizing their differences and how they can be applied in supervisory and industry contexts.

3.1 Foundational Elements

Three key elements – climate risk horizons, objectives and analytical questions, and tools – can shape the structure of an SCRM exercise. We have used these elements as a foundation for differentiating the Reference Approaches.

Climate risk time horizon

Certain key climate-related milestones in the coming decades will shape the nature and dynamics of physical and transition risks, and ultimately orient the climate change pathway the world will be on. Scientific consensus advanced by the IPCC has indicated that reducing the most extreme risks from climate change by limiting global warming to 1.5°C

requires significant reductions of CO₂ emissions, leading to the achievement of Net Zero emissions by 2050²⁷. The translation of this long-term goal into an emissions reduction pathway brings forth several distinct milestones over the future “climate risk horizon” over the next several decades. These include:

- **2030:** 50% reduction in CO₂ levels compared to 2010 is required to give a high probability of being in line with a Net Zero trajectory, implying a rapid transition with orderly (or disorderly) characteristics.
- **2050:** Net Zero emissions (or significant reductions) required to limit global warming to 1.5°C; significant overshoot of a Net Zero emissions trajectory will lead to widespread and costly physical risks manifesting by end-century.

Recent analyses – including the IEA Net Zero Scenarios Roadmap²⁸ – provide a detailed view of the scale of this economic transformation challenge, in terms of complete decarbonization of electricity generation, shifts to low-carbon energy and fuel sources.

Considering their long-term nature and unique characteristics, climate risks are requiring banks and supervisors to extend the time horizon over which they would traditionally assess risks, hereafter referred to as the “risk time horizon”. Many banks and other financial institutions have started to assess the risks and opportunities presented by climate change, accounting for potential near-dated and longer-term effects. Many climate-related risks are chronic and are projected to have the greatest environmental, societal and economic impacts over the medium to long-term, unless mitigating action is taken in the near-term. Such risks, and the planned public and private sector responses to them, is expected to produce structural changes for the global economy and financial system, which financial institutions are increasingly accounting for in their own strategic planning and client engagement. At the same time, other climate-related risks – including acute non-linear physical risk events such as extreme weather, or transition risks such as sudden policy changes or shifts in market sentiment – may crystallize and contribute to financial risks in the much nearer term.

Some prudential supervisors are considering how to account for climate-related risks within the traditional supervisory risk time horizon, and whether they need to ‘stretch’ their horizon to account for longer-dated risks that could present structural or future systemic challenges. The traditional bank supervisory risk time horizon extends out approximately 3-5 years – as seen in supervisory handbooks and financial resilience stress testing²⁹ – in line with normal business planning horizons. Outside of stress testing, the bank prudential capital time horizon is usually much shorter; for example, risk weights for credit risk in the banking book are normally calibrated to account for unexpected losses over a one-year horizon, and market risk in the trading book is calibrated for risks that can crystallize over a much shorter horizon given the shorter-dated nature of those exposures. Nevertheless, prudential authorities have long monitored and accounted for longer-term risks to the banking

²⁷ The Intergovernmental Panel on Climate Change, “[Global Warming of 1.5 °C](#), 2018.”

²⁸ International Energy Agency, “[Net Zero by 2050: A Roadmap for the Global Energy Sector](#),” May 2021.

²⁹ For example, see Financial Stability Institute, “[Stress-testing banks – a comparative analysis](#),” November 2018.

system, such as the impact of very low interest rates. Many supervisors climate-related risks to be an important example of a medium- to longer-term risk that should be on their radar.³⁰

Different risk time horizons are useful for answering different questions. In a climate context, it can be useful to consider near-term, medium-term and long-term supervisory risk time horizons, and explore how supervisors' mandates and objectives translate to each. For this, different types of SCRMM tools should be applied, and the prudential implications of analysis should differ accordingly.

Objectives and Analytical Questions

In the case of supervisory exercises, certain design choices are likely to be especially important if the supervisor is pursuing certain micro- or macro-prudential objectives, or potential supervisory or prudential applications. Microprudential supervisory questions focus on the safety and soundness of a financial institution as near-term or medium-term risks crystallize affecting their balance sheet or broader business model and strategy; these are questions which financial institutions themselves examine as part of their risk management and strategic planning. Macroprudential supervisory questions relate to potential system-wide implications of certain risks (for example, if the banking system is highly exposed to an economic sector that could be negatively impacted by climate change or the low-carbon transition) and whether there are mechanisms within the financial system that might amplify the effects of climate-related risk, including cross-sectoral (e.g., between banking and insurance industries) or cross-border risk channels.³¹

A wide range of supervisory objectives can be pursued with SCRMM exercises, including building awareness, analyzing data gaps and capacity building within the public and private sectors. Some supervisory SCRMM exercises have broad macroprudential and microprudential objectives. For example, BoE (2021) was intended to size financial exposures to climate-related risks for individual institutions and the broader financial system, understand challenges to business models, and assist participants in enhancing climate-related risk management. ACPR (2021) had similar objectives, and was also explicitly intended to raise awareness about climate risks and mobilize financial institutions to assess them. Other exercises have been focused on a narrower set of objectives; for example, EBA (2021) was designed as a learning exercise to investigate the performance of climate risk assessment and classification tools, and to test participating banks' readiness to deal with data and methodological challenges.

Certain design choices in areas such as scope and format can have major implications for the robustness and implementation feasibility of an exercise. For instance, an exercise that is oriented towards raising awareness about the potential long-term risks that climate change

³⁰ The Basel Committee on Banking Supervision (BCBS) [2021 work programme](#) notes that "The Committee will pursue a forward-looking approach to identifying, assessing and mitigating risks and vulnerabilities to the banking system. It will analyse the implications for banks and supervisors of medium-term structural trends and disruptions to the global banking system. [including] The assessment, measurement and mitigation of climate-related financial risks ...".

³¹ Financial Stability Board, "[The Implications of Climate Change for Financial Stability](#)," November 23, 2020. Hereafter referred to as "FSB 2020."

may pose to the economy may be best suited to a higher-level and less granular analysis that focuses on breadth of coverage (e.g., across different types of financial institutions), with a focus on long-term scenarios to explore what a hypothetical 'worst case' scenario outcome could mean for financial stability.

Greater clarity on the immediate and potential longer-term objectives of exercises is key; banks need to know what to expect in terms of how the prudential framework, and other tools, could be influenced by SCRM exercises. This is necessary to help shape support mutual understanding of the potential applications of the results of exercises, including in the context of the prudential framework (see Section 3.3).

Tools

As discussed in Section 1, two predominant types of tool for SCRM are climate scenario analysis and climate stress testing. Consensus between supervisors on the need to differentiate between scenario analysis and stress testing is emerging within the BCBS; however, further clarification is needed on how these tools are relevant across time horizons, prudential objectives, and to potential supervisory applications.

- ❖ For the purposes of this report, we consider **climate scenario analysis** to be a forward-looking risk measurement tool to assess the potential for climate risk drivers to give rise to financial stability or institution-specific financial risks under a plausible range of **medium to long-term scenarios**.
- ❖ We consider **climate stress testing** to be the assessment of a financial institution's balance sheet resilience, or financial system-wide resilience, to climate-related risks that could plausibly crystallize over the **near-term business planning horizon**.

Further detail and differentiation between the two tools follows below.

Climate Scenario Analysis

Climate scenario analysis is a flexible and versatile risk measurement tool that can be used to assess the sensitivity of individual banks, or the financial system as a whole, to complex scenarios that can span decades - such as the NGFS Reference Scenarios. This type of analysis can be used to size potential risks under different courses of action by financial institutions, and explore the interactions between economic sectors and the financial system under alternative climate pathways. Given the increasing modelling uncertainty over time, it can be more informative and a better representation of the modelling accuracy to assess potential financial losses - to a firm, group of firms or broader financial system - at a few key representative intervals across the scenario horizon.

While the instinct is to make climate scenario analysis a highly quantitative and integrated exercise, several firms and authorities have recognized the value of a narrative-driven qualitative approach at least in the first phase of exercises and while data and modelling tools are still under development. The Australian Prudential Regulation Authority (APRA) has commented that: "*Qualitative scenarios can still provide insights into the*

operations and channels of risk transmission, and findings from such an assessment can be reflected in business plans, strategies and risk management practices.”³²

Depending on how they are structured, climate scenario analysis exercises can be used to investigate macroprudential or microprudential supervisory questions, or a mix of both.³³ Whether a supervisory-driven climate scenario analysis exercise is used for macroprudential or microprudential purposes will influence whether it is conducted by the supervisory authority or supervised institutions themselves, and the scope of financial institutions covered by the exercise. A mix of supervisor-conducted and firm-conducted exercises have been used by authorities to date, and several exercises have included banks and other financial institutions including insurers (such as ACPR (2021) and BoE (2021)) and asset managers (e.g. BAFU (2020)).

While multiple factors will change over the course of the coming decades beyond what can be specified in a specific scenario, simplifying assumptions are required in scenario analysis for tractability. For example, financial institutions, economic actors and policymakers will certainly take actions in response to significant exogenous events as they unfold. Depending on the specific research question and objective of the exercise, SCR analysis could account for mitigating actions by financial institutions and adaptation plans of their clients, either quantitatively (for example, modelling a changing balance sheet of the financial institution) or qualitatively as an overlay. However, this is a challenging endeavor and raises a number of choices about exercise design and assumptions, which are further discussed in Section 3.2.³⁴

Climate Stress Testing

Conceptually, climate risk drivers could one day be embedded within a bank’s internal stress test, or a supervisor’s stress test, to assess balance sheet resilience if extreme but plausible events occur over the business planning horizon. Stress testing can provide insights into the impact on resilience of risks that could crystalize in the near-term - for example, the 1 to 5 year business planning horizon - and for which a bank has fewer options to adjust for. Examples could include a so-called “climate Minsky moment” in financial markets stemming from sudden and rapid shifts in market sentiment, or physical risk events that are already regular occurrences in many parts of the world including seasonal flooding. However, we believe it would not currently be appropriate to use climate stress testing as an input to capital adequacy assessment, for reasons discussed in Section 3.2.

While macro-financial stress testing is now common, climate stress testing for financial institutions is an emerging field which still requires much development. Financial

³² APRA, “[Prudential Practice Guide: Draft CPG 229 Climate Change Financial Risks](#),” April 2021.

³³ IIF, “[Prudential Pathways: Industry Perspectives on Supervisory and Regulatory Approaches to Climate-Related and Environmental Risks](#),” January 21, 2021.

³⁴ Accounting for endogenous reactions to a shock by economic agents within a scenario-based exercise can give rise to so-called “second-round effects”. While much research has been undertaken over recent years to incorporate second-round effects into traditional macro-financial stress testing, it is still an extremely challenging endeavor and there is no established approach for it. As discussed in [Bank for International Settlements](#) (2018) and [appendix](#).

institutions are still researching and gathering data to understand the relationship between transition or physical risks and financial risks – for example, probability of a counterparty default or impact on the value of physical collateral. Historical data are of limited help in understanding the statistical relationships or co-movements between variables, including in the case of transition risks that could reverberate between financial markets and affect several market prices.

3.2 Key Design Choices within an SCRMs Exercise

Beyond the foundational elements described above, a large number of design choices need to be made before undertaking an SCRMs exercise. This section discusses the range of options in six categories: scenarios, scope, format and specification, modelling assumptions, outputs, and application of results.

Considering the state of maturity of SCRMs approaches, some design choices warrant special consideration and may benefit from further development. As practice is evolving and supervisors and firms continue ‘learning by doing’, it may be helpful to consider where further development and alignment can help uncover new insights in critical areas – for instance, how risks could transmit between different parts of the financial system, or how firms’ capital reallocation and strategic repositioning associated with Net Zero commitments could affect the provision of capital to the economy.

Key Design Choice:
Scenarios

Key feature	Specific Design Choice	Overview of Options
Scenarios	Scenario Source Information	<ul style="list-style-type: none"> • NGFS Reference Scenarios (first released in 2020, update Phase II scenarios released in 2021) serve as a global reference for integrated scenarios that supervisors and firms can employ to analyze climate risks to the economy and financial system. • Other scenarios and data resources provided by international entities (e.g. IEA) can be used to assess specific transition risks, including sectoral pathways. • Bespoke scenarios can be designed, often to investigate specific physical risks. • One potentially important choice that affects the interpretation of results relates to the implicit or explicit reference point or ‘base case’ – i.e. what stress impacts under various scenarios are compared to. The choice of base case may differ depending on the analytical questions being examined.
	Climate Risk Horizon	<ul style="list-style-type: none"> • Climate trends and risks often explored over period of multiple decades (e.g. NGFS climate impacts out to 2100 in 5-yr time steps). • Economic projections can span decades (e.g. NiGEM quarterly econometric model with time horizon to 2050), but traditional macro-financial stress testing has focused on a 1-5 year horizon for solvency purposes. Liquidity stress testing is often much shorter (days or months). • Time horizons of some scenarios are specifically linked to key climate/economic milestones, for instance, achievement of Net Zero emissions by 2050 (IEA scenarios extend to 2050 to reflect countries’ policy commitments)

		<ul style="list-style-type: none"> For risk management and capital allocation, bank internal models typically calibrated to assess financial risks over a shorter time horizon: e.g. 1-5 years for credit risk, up to 1 year for market risks, reflecting maturity of exposures.
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To the extent possible, supervisors and firms should seek to leverage a common set of scenarios for SCRMs exercises - and the IIF recommends that both firms and supervisors seek to leverage the Phase II NGFS Reference Scenarios in SCRMs exercises as a common foundation. Released in June 2021, the revised Phase II Reference Scenarios include a number of important developments and upgrades (see Box 3), which will likely further secure their role as a foundational resource in industry and supervisory exercises.³⁵ Six Reference Scenarios are provided, grouped into three main categories depending on whether they align with low or high transition and physical risks. Figure 6 provides a summary of the NGFS Phase II Reference Scenarios and the abbreviated labels assigned to each scenario for brevity in this report.

Figure 6: NGFS Phase II Reference Scenarios

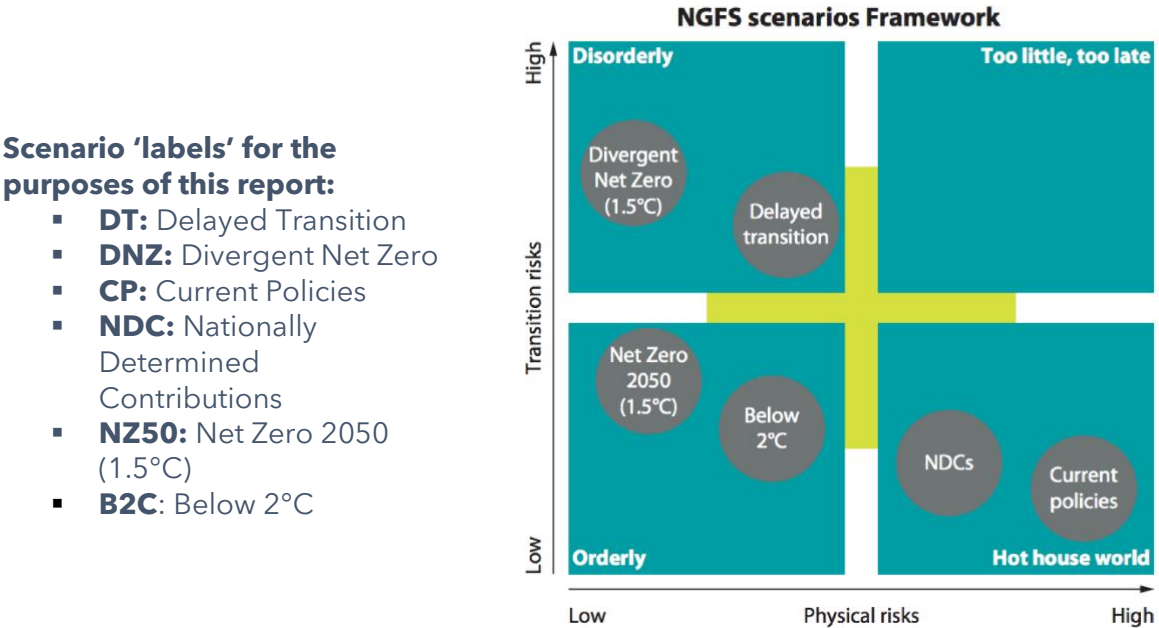


Figure notes: Network for Greening the Financial System, “[NGFS Climate Scenarios for central banks and supervisors](#),” June 2021. Slide 7.

The NGFS scenarios have been developed to be run with three alternative Integrated Assessment Models (IAMs) - GCAM, MESSAGE-GLOBIOM and REMIND-MAGPIE. While key policy assumptions are aligned across the IAMs, they differ in other important respects. This results in a range of variable pathways under a given Reference Scenario: depending on the IAM used, and the key model inputs (e.g. energy prices, carbon prices), a scenario can result in different output projections for similar economic sectors or

³⁵ Network for Greening the Financial System, “[NGFS Climate Scenarios for central banks and supervisors](#),” June 2021. Hereafter referred to as “NGFS 2021 (June).”

counterparties, including at the country level.³⁶ While this variability is an intentional design feature by the NGFS to allow users to compare scenarios under different modelling approaches, it does introduce greater dimensionality and potentially a risk of mis-estimation of the impacts at an aggregate level if users place weight on different model outcomes. As such, supervisors should seek to clarify the pathways of key variables in order to reduce risk of comparability issues or unintended biases in results. Further work may be required to conduct a detailed analysis of the differences of scenario outcomes across different IAMs; as such, we do not comment on the suitability or relevance of a specific IAM in this paper.

As the Phase II Reference Scenarios were only recently released, financial institutions do not yet have experience applying them in internal analysis or supervisory exercises. With time, further work will be required to assess to degree to which the Phase II scenarios address challenges that financial institutions and supervisors have encountered in efforts to conduct SCRM exercises.

Looking ahead, three topics stand out for further analysis and development:

- **Adaptation of NGFS scenarios to reflect jurisdictional context:** Considering the diversity of climate-related issues that may manifest at jurisdictional levels, supervisors will need to tailor exercises relevant to their geographic, market, and financial system context. Supervisors have taken a range of approaches to adapting the NGFS Reference Scenarios to suit local contexts. An interesting example in this regard is the approach taken in BoE (2021) to better reflect the specifics of the UK energy mix³⁷. The Phase II Reference Scenarios recently released by the NGFS enable users to “downscale” global scenarios to local contexts through the provision of jurisdictional-level data on key transition and physical risk variables. While many of the values are inferred, and as such are not fully reflective of jurisdictional realities, the new data can provide a basis for more detailed scenario specifications and adaptations, including in emerging markets.
- **Use of additional scenarios reflecting financial institution-specific context:** Specifically in the case of the internal use of SCRM exercises by financial institutions, discussion with the project participating banks indicates that there may be certain circumstances where the use of additional scenarios may be required. These judgements may pertain to either specifics of a firms’ business model, a concentration of specific risks (including localized physical risks within a given jurisdiction), or for specific investigation of sectoral transition pathways, e.g. using third-party models.
- **Further consideration of the reference point or ‘base case’ in climate scenario analysis in terms of physical risk impacts:** The NGFS Reference Scenarios contain an expectation of a base level of climate-related damages and economic impact across all

³⁶ See NGFS 2021 (June). *“The three integrated assessment models differ in key respects, allowing users to compare scenarios under different modelling approaches. ... IAMs differ in a few important ways, including their policy and technology assumptions, regional and sectoral granularity, and how they are solved (e.g. representative agent objectives and anticipation of the future). ... Policy assumptions have been aligned across the three IAM models used by the NGFS so the user can see how other assumptions drive differences in the results.”*

³⁷ Bank of England, [“Key elements of the 2021 Biennial Exploratory Scenario: Financial risks from climate change.”](#) June 8, 2021. See footnote 15.

future climate pathways. This reflects current scientific consensus that the world will face an increase in physical risks even if a 1.5°C scenario is achieved. New scientific evidence suggests that due to lags in the climate system (in terms of when physical risks will manifest following an increase in the ‘climate forcing’ effects of anthropogenic CO₂ emissions), it is likely that the level of physical impacts that can be expected at a given level of global average temperature increase are likely to be more severe than previously predicted. Recent examples of major climate-related natural disasters – including large scale forest fires, storms, and the recent extreme heat of June 2021 in North America, which saw decades-old temperature records broken by 5-7°C – are examples of what can be expected at slightly over 1°C of warming. Going forward, banks and supervisors should consider the risk that the likely ‘worst case’ physical damages associated with a given level of temperature rise are significantly underestimated. Looking at chronic risks, there are a range of threshold effects which may result in such risks becoming ‘acute’ at a certain time – for instance, increases in wet-bulb temperatures to a level that prevent outdoor labour, or attritional impacts of flooding rising beyond the resilience thresholds of critical infrastructure. Supervisors and firms may seek to identify key priority physical hazards and exposures for consideration in the base case, and assess how risks are likely to be exacerbated at higher levels of warming.

Box 3: Industry Feedback on NGFS Reference Scenarios

In June 2020, the NGFS released a set of Reference Scenarios for climate risks, which have emerged as a de-facto global benchmark for SCRMs exercises by supervisors and the banking industry. These scenarios were accompanied by a ‘*Guide to climate scenario analysis for central banks and supervisors*’³⁸ providing suggestions for supervisors on how to use scenario analysis to assess climate risks to the economy and financial system.

The global banking industry is highly supportive of the NGFS Reference Scenarios and the NGFS’s objective that they be used to anchor scenario analysis exercises undertaken by supervisory authorities and financial institutions. 40% of the project participating banks have already tried to apply the Phase 1 NGFS scenarios internally; the percentage is higher (46%) in a larger sample including other IIF member financial institutions. The banking industry is in favour of applying this approach to other aspects of supervisory scenario-based climate risk measurement.

The NGFS scenarios capture events that could unfold over a 50-year risk time horizon, which is appropriate from a climate science perspective. Nevertheless, banks’ degree of confidence in measuring risks to their balance sheets and business models drops sharply as the risk horizon lengthens. In general, in the global sample of banks we surveyed, the highest degree of confidence for robustly modelling balance sheet impacts from climate risks was ‘Medium’ or ‘Low’. See heatmap below - there is relatively the highest degree of confidence in modelling transition and physical risks over a 5-year horizon.

³⁸ Network for Greening the Financial System, “[Guide to climate scenario analysis for central banks and supervisors.](#)” June 24, 2020. Hereafter referred to as “NGFS 2020 (June).”

Figure B3.1: Heatmap of aggregate expressed confidence by project participating banks in modelling the potential financial impacts of physical or transition risks over different time horizons

Physical risks			
5 years	10 years	30 years	50 years
			Lowest Confidence
Transition risks			
5 years	10 years	30 years	50 years
Highest Confidence			

Figure notes: Based on subjective, self-reported data. Banks were asked to indicate their degree of confidence choosing between high, medium, low and no confidence. Aggregate results from across the 20 banks shown here at each time horizon. Darker red indicates relatively least confidence, darker blue indicates relatively more confidence; however, in aggregate, absolute levels of confidence expressed ranged between low and no confidence. Some individual banks did express medium or high confidence for some risks, at some time horizons.

One general challenge in applying the NGFS Reference Scenarios is consistently translating them to macroeconomic and market variables for the purposes of financial risk measurement, for example, inclusion within standard risk models. This was recognized by the BCBS in their 2021 report on “Climate-related financial risks – measurement methodologies”.³⁹ Greater clarity on approaches to translate scenario variables would help drive consistency in their application. In addition, while important for driving consistency, some banks thought they would need to be adapted in some ways for maximum relevance within each jurisdiction. For example, to reflect local economic, technological, social and financial market conditions. Some banks thought that NGFS scenario variables would need to be expanded for greater granularity for some geographic regions and economic sectors.

Many of these challenges have been addressed by the NGFS in the revised Phase II of Reference Scenarios, which were released in June 2021⁴⁰. The updated scenarios now reflect commitments of countries and jurisdictions to reach net-zero emissions, and have been enriched with an expanded set of macroeconomic variables at country-level granularity. Transition and economic variables were produced by external research partners and can be accessed in an NGFS Scenarios Database. Physical risk data, such as projections of physical climate change indicators, are made available via the NGFS CA Climate Impact Explorer on a national and subnational level.

The Phase II scenarios offer significant improvements on the Phase I scenarios, but they yet have to be applied in practice. Climate scenarios will need to evolve over time to keep pace with the latest scientific knowledge and research, and changing climate and economic conditions. Industry stakeholders have express concern regarding the validity of some of the underlying assumptions, for instance a potential over-reliance on CO₂ removal technologies such as carbon capture and storage. The IIF and its member firms therefore welcome that

³⁹ BCBS 2021 (April). “Another significant challenge mentioned by banks and supervisors has to do with the ability of financial risk models to factor in variables linked to climate scenarios.” (page 41)

⁴⁰ NGFS 2021 (June).

the NGFS will continue to develop the scenarios to make them more comprehensive and as relevant as possible for economic and financial analysis. The IIF also welcomes that the NGFS has plans to further develop the Reference Scenarios, for example by including an explicit role for the financial sector in transition pathways.

Key Design Choice:
Scope

Key feature	Specific Design Choice	Overview of Options
Scope	Institutions	<ul style="list-style-type: none"> Relevant for supervisory SCRM exercises, supervisors need to determine the sample of financial institutions to be included in the exercise. Could be sectoral focused (e.g. banking institutions only), or cross-sectoral (e.g. across banking, insurance and/or asset managers/pension funds). Size or systemic importance can be a dimension along which to determine supervisory exercise participation. Choices also need to be made about the level of consolidation and treatment of national vs. foreign entities (e.g. subsidiaries of foreign banks).
	Financial risks	<ul style="list-style-type: none"> SCRM exercises can be scoped to explore the impact of climate risks on one or more financial risk stripes (credit, operational, market, etc). The choice can be based on relevance to the scenario, relevance to the in-scope institutions and for practical reasons such as exercise feasibility and firms' capabilities.
	Geographies	<ul style="list-style-type: none"> Scenarios can explore global risks and/or certain jurisdiction-specific risks to different degrees of granularity. The desired granularity of analysis for certain geographic locations influences the necessary data collection and variable specification. Physical risks are often examined within specific geographies.
	Exposures (Sectors, Portfolios, and Counterparties)	<ul style="list-style-type: none"> "Top-down" scoping used to describe a process of determining the scope of exposures covered by an SCRM exercise by first specifying certain economic sectors or portfolio types (e.g. residential real estate). "Bottom-up" scoping is the process of determining the scope of an exercise based on institution-specific characteristics such as the largest counterparties, largest exposure types, etc. Combinations of top-down and bottoms-up scoping are possible. Different cut-offs can be used to determine the most material sectors, exposures or counterparties.

The four key scoping dimensions of an exercise - institutions, financial risks, geographies, and exposures (sectors, portfolios, and counterparties) - are closely related, and can be considered as contingent. For instance, for long-term exercises oriented to investigate macroprudential issues and assess potential risks to financial stability, it may be desirable to analyze financial institutions from multiple sectors to understand system-wide risk exposures and dynamics, including interlinkages through intra-financial or correlated exposures. Considering multiple sectors can enable supervisors to assess a broader array of risk transmission channels, both within the financial system (e.g. between insurers and banks) and also the broader economy.

While scoping choices are likely to be influenced by local financial and macroeconomic contexts (which will shape which types of firms may be most affected by climate risks, and the types of exposures that will comprise these risks), there are a number of scoping aspects where further development and broader agreement on a set of common practices may be beneficial:

- **Common definitions for climate-sensitive sectors:** To generate the most meaningful insights on the transition risk side, SCRMs exercises should focus on the most material financial risks from an array of climate-sensitive sectors - including energy, transportation, materials and buildings, and agriculture - as opposed to a narrow view of 'carbon-related assets'. This would reflect the evolution of firms' assessment of risks in the context of TCFD reporting,⁴¹ and proposed changes to the TCFD framework itself which would expand the definition of carbon-related assets from the energy sector to a wider set of non-financial groups⁴². Supervisors have taken a range of approaches to specifying sectoral scope; for example, the ACPR provided institutions with a detailed taxonomy of 22 sectors and groups of sectors to be considered as part of the credit and transition risk analysis in their 2021 exercise.⁴³ Going forward, there may be value in developing public-private consensus on the definition and delineation of climate-sensitive sectors, which can be updated over time, for purposes of scoping SCRMs exercises. On the physical risk side, the delineation of which sectors may be exposed to localized impacts of physical risks will stem from choices regarding the geographic scope of an exercise.
- **Common approaches to sectoral and counterparty-level analysis:** Choices pertaining to the range of counterparties that should be considered within an exercise, and the granularity of assessment, can have significant impacts on implementation feasibility. Supervisors may seek to share lessons from exercises where highly granular approaches have been taken for transition risk assessment (e.g. assessing the top 100 largest counterparties within an given climate-relevant sector), or in the context of physical risk analysis, including insights on the spatial granularity of analysis required to robustly assess exposures to real estate or physical assets. However, considering the complexity of counterparty level analysis at large scale, a balanced solution could be to start with a sectoral/sub-sectoral approach coupled with a deep dive at the counterparty level for the most important portfolios or exposures. The associated data collection and assurance challenges should also be addressed in a collaborative way (further discussed under 'Format and Specification').
- **Best practices for assessing climate risk transmission channels between financial sub-sectors, and at portfolio level:** The potential for climate risks to have spillover effects within the financial system - for instance, a significant increase in risk pricing within the insurance sector affecting the cost of bank credit - is a recognized, yet under-researched area in climate risk analysis. Certain supervisors have set out frameworks for

⁴¹ IIF/UNEP-FI (2020), "[IIF/UNEP-FI TCFD Report Playbook](#)," September 28.

⁴² TCFD (2021), "[Proposed Guidance on Climate-related Metrics, Targets, and Transition Plans](#)," June. "The proposed changes also expand the definition of exposure to carbon-related assets from the energy sector group to all non-financial sector groups identified in the 2017 TCFD Annex."

⁴³ Based on NACE sector classifications. See Annex B in ACPR, "[A first assessment of financial risks stemming from climate change: The main results of the 2020 climate pilot exercise](#)," 2021.

assessing the potential risk transmission channels that may warrant consideration and some authorities have included banks and insurers within pilot SCRM exercises to investigate these questions (e.g. ACPR (2021), BoE (2021)). However, there have been few SCRM exercises to date which have directly addressed how risk transmission channels may result in contagion effects. Industry and supervisory collaboration at jurisdictional and international levels could be beneficial to explore these issues, and identify best practices for how SCRM exercises can be scoped to gather meaningful and decision-useful insights.

**Key Design Choice:
Format and Specification**

Key feature	Specific Design Choice	Overview of Options
Format and Specification	Execution	<ul style="list-style-type: none"> • Relevant for supervisory SCRM exercises, the analysis could either be conducted by the supervisory authority ('supervisor-conducted') or by the participating institutions ('firm-conducted'). • In the case of supervisory-conducted exercises, sometimes data are requested from a group of financial institutions to inform the analysis. • In supervisory exercises, it is possible to partition exercises into two 'rounds', where primary analysis is conducted on portfolio data, and a secondary round is then conducted to assess potential indirect, second-order, or system-level risks. The first round could potentially be conducted by financial institutions, even if the first is conducted by the supervisor.
	Reporting intervals	<ul style="list-style-type: none"> • The stages at which impacts are assessed within the exercise; can be considered as intermediate time horizons or steps within the overall scenario time horizon. • The choice of number of time horizons can relate to several factors such as overall time horizon, overarching analytical questions being investigated, type of model used and its temporal resolution and modelling confidence over different time horizons. Practical factors are also important; intervals should be kept at a reasonable level to support implementation feasibility.
	Variable choice/specification	<ul style="list-style-type: none"> • Related to the scenario, a range of climate (transition, physical), macroeconomic and financial variables are important in SCRM exercises in order to translate the impact of the scenario on the economy and financial institutions. Exercises that cover a wider range of climate or financial risk types, a wider number of portfolios or geographic regions will require greater variable specification. Variable pathways should be linked to the overall scenario narrative. • In supervisory SCRM exercises, supervisors need to decide which variables they will specify for participating financial institutions. Variables that are not provided by the supervisor will otherwise need to be derived by individual institutions and will vary between firms. As such, supervisors may wish to engage with firms to identify the optimal balance of comparability, desired heterogeneity, institutional capacities, and relevance of results for firms.
	Model choice/specification	<ul style="list-style-type: none"> • Climate and economic models are used to derive scenario narratives and variables. Models are also required to estimate the firm-specific financial impacts or aggregate financial stability impacts of the scenarios. This type of modelling is still developing. One approach is to adapt current internal models to account for new types of shock or different variable

Key feature	Specific Design Choice	Overview of Options
		<p>pathways, however there are challenges with this approach particularly for long-dated risks that are beyond the horizon of traditional modelling.</p> <ul style="list-style-type: none"> In supervisory SCRMs exercises, if supervisor-conducted then the supervisor must specify the model(s) and would apply the common model(s) across all financial institutions. If firm-conducted, supervisors need to decide whether or not to specify certain models for the analysis.

The format and specification of SCRMs exercises involves a broad set of design choices, which range from the operational to the technical in nature.

A fundamental choice is on the execution responsibilities of an exercise, specifically, whether the analysis is conducted by a participating firm on the basis of internal data, or conducted by the supervisor on the basis of data submitted by participating institutions. Many banks welcome supervisory SCRMs exercises which are firm-conducted, or involve a firm-conducted component, as this can help catalyze development of internal capabilities, and the results of analysis conducted in-house may be more tractable in the context of strategy development. However, supervisor-conducted exercises can play an important role particularly in the case of initial analyses when data or technical capabilities are not yet widely advanced within the banking industry, as may be the case in some emerging market or developing economies at present, or in the case of higher-level system-wide analysis which benefits from breadth and a top-down modelling approach.

A range of specification issues - including judgements on variables and modelling approaches - are contingent on **data availability and quality**, which varies significantly across risk types and exposure types, and diverges across markets (as discussed in Box 1). As noted above, the provision of a consistent set of climate risk and macroeconomic variables for adaptation to local contexts will be an extremely helpful contribution for firms and supervisors in emerging markets.

A key emerging issue that warrants further consideration is how participating firms should source and employ **data from counterparties necessary to inform assessments of portfolio-level risk exposures**. Such data may be sourced through internal client engagement as well as public disclosures, and the use of **proxy data**. Banks are highly reliant on data proxies at present, leading to questions about the best proxies and ways to standardize proxy techniques, which are particularly important for comparability of results in supervisory exercises. It would be valuable to for the public and private sectors to work together to develop commonly accepted approaches for proxying key variables, which are feasible to produce and accepted by supervisors in supervisory SCRMs exercises.

Key Design Choice:
Modelling Assumptions

Key feature	Specific Design Choice	Overview of Options
Modelling Assumptions	Balance sheet assumptions	<ul style="list-style-type: none"> It is necessary to make assumptions about the evolution of financial institutions’ balance sheets over the time horizon of the SCRM exercise. Balance sheets could be assumed to remain fixed (or ‘static’) throughout, which can be chosen to simplify the analysis or to ask “What if?” questions. Or balance sheets can be assumed to change over the course of the scenario, referred to as a “dynamic balance sheet” assumption. Different approaches can be taken to approximating balance sheet changes in the case of dynamic balance sheet exercises; this can relate to assumptions about counterparty and bank management actions. The relevance of applying a dynamic balance sheet assumption – and the of this approach – is linked to the time horizon of an exercise.
	Counterparty assumptions	<ul style="list-style-type: none"> In order to approximate the financial impact of physical or transition risks, assumptions are required about how they affect a financial institutions’ counterparties (corporate, retail, sovereign, etc. depending on exercise scope). At one end of the spectrum, an option is to assume that counterparties do not change their characteristics (business model, physical location) or take mitigating actions for the risks. Alternatively, it is possible to use information about counterparty adaptation plans or commitments to make adjustments to the expected impacts; however, as such analysis is highly complex and involves subjective assumptions, it may be difficult to deliver at large scale.
	Bank management actions assumptions	<ul style="list-style-type: none"> In calculating the financial impact of a scenario, it is necessary to decide whether or not the exercise will account for mitigating actions or provisions by the financial institution itself. For example, whether or not the institution will reduce the portfolio share of exposures subject to high climate risk or if counterparties do not take action to reduce risks. It is also possible to account for ex ante climate commitments made by the financial institution. Similarly, financial mitigants such as insurance could be considered. It is possible to account for these directly in any quantitative outputs, but also qualitatively when interpreting the outputs.
	Second-round effects	<ul style="list-style-type: none"> First round effects are defined as the direct impact of shocks on individual banks’ business and balance sheet, taking each bank in isolation. Second-round effects may occur as a response from banks, depositors, financial markets, policymakers and other economic agents to the impact of the initial shocks on banks, which can amplify the initial shock(s) in the scenario. It is necessary to decide whether to model second-round effects; there is still no common view on this in traditional macro-financial stress testing, but second-round effects are often incorporated to assess system-wide dynamics and risk channels.

Modelling assumptions - including balance sheet dynamics, management actions, counterparty behaviour, and second-round effects - can help shine light on the dynamics of banks’ and the broader financial system’s response to future climate-related risks and trends. As such, the treatment of these assumptions - and the consideration of how they may interact over a scenario horizon - can have significant impacts on the results of exercises. For

instance, the capacity of institutions to reduce exposures to future risks through portfolio diversification and divestment will be a determining factor in the potential aggregate exposure a firm may face at a given point over the time horizon. At a more macro level, widespread shifts in portfolio reallocation by the financial system would have broader macroeconomic impacts and could have implications for financial stability, which could lead to a range of second-round effects.

Due to the complexity of accurately reflecting these dynamics, most exercises to date have considered portfolio, strategic, or counterparty dynamics in a fairly limited way. A notable exception is ACPR, which took an innovative approach considering financial institutions' climate-related commitments. Ideally, exercises could account for all such dynamics to provide a holistic view of potential risks across different scenarios, and the impact of mitigating actions on the likelihood of a given scenario occurring. However, it is not possible to reasonably assess all of these factors at any point between today and 30+ years in the future, and there are important questions about how much an exercise should "bake in" policy or strategic commitments which may change over time.

The medium-term horizon (to 2030) is where assessment of the implications of portfolio dynamics and changing strategies can help shape banks' and supervisors' understanding of the pathway the economy will be on in the longer term. For instance, an increasing orientation of the financial sector towards Net Zero would have significant implications for the speed and shape of the transition path. It would be extremely helpful to be able to map out how banks' balance sheet dynamics, strategic choices – and, most importantly, the strategies of their counterparties – may evolve over coming years. Technical barriers to this type of analysis are significant, but we would strongly encourage supervisors and industry to collaboratively develop the thinking and techniques on this topic.

Some challenges related to modelling dynamics over the transition are innate to SCRM exercises with long risk time horizons, and should be accounted for in the application of results. The BCBS has commented that: *"The further planning horizons extend beyond current asset durations, the less reliable are static balance sheet assumptions as reasonably realistic representations of future risk pathways, which limits their utility for identifying risk mitigation strategies or testing capital adequacy."*⁴⁴ While dynamic balance sheet assumptions in exercises with longer planning horizons could be informative to assess risk mitigation strategies, the judgement and assumptions required suggest that medium- to long-term SCRM analysis are not appropriate tools to assess capital adequacy (see below).

⁴⁴ BCBS 2021 (April).

Key Design Choice:
Outputs

Key feature	Specific Design Choice	Overview of Options
Outputs	Quantitative	<ul style="list-style-type: none"> In quantitative SCRM exercises, there is a wide variety of possible quantitative output variables summarizing the results including impacts on balance sheet and off-balance sheet variables and risk metrics, portfolio alignment metrics or impacts on regulatory metrics (or proxies). The appropriate choice of output variables depends on analytical questions, time horizon, and other factors. Metrics to indicate the range of uncertainty in the results can also be informative. In supervisory SCRM exercises, it is possible to benchmark individual institution impacts against peers in the sample as part of the feedback to participants.
	Qualitative	<ul style="list-style-type: none"> SCRM exercises can deliver a range of qualitative outputs, for example relating to key challenges experienced, explanations of uncertainty of results, information about strategic responses to exercise findings, information about perceptions, etc. In the case of supervisory SCRM exercises, this information can be gathered via qualitative questionnaires to participating institutions or through supervisor-institution dialogue during the exercise.

The results of SCRM exercises may be expressed in quantitative or qualitative terms, and often as a combination of the two. The orientation of an SCRM exercise should shape the choice of metrics and variables used to express results. Long-term, system-level exercises involving higher levels of uncertainty may be more meaningfully described through the use of qualitative narrative information, and select quantitative variables (e.g., indicating industry risk exposures at aggregate levels), rather than regulatory variables which may provide spurious precision. In the case of near-term climate stress tests, it could be appropriate to estimate the impact on firm-specific regulatory variables (or proxies). In supervisory SCRM exercises, it can be informative to benchmark individual institution impacts against peers in the sample as part of the feedback to participants. Looking forward, supervisors and banks can collaboratively explore other types of climate-related metrics that could make these exercises more decision useful for banks.

Exercise outputs should be distinguished from public disclosures of the results of SCRM exercises - given the sensitivity of SCRM exercises, an appropriate degree of disclosure of the aggregate results to the broader public would need to be carefully considered. Certain information may not be appropriate for public disclosure (e.g., if measured with a high degree of uncertainty, or if commercially sensitive), and most data would benefit from aggregation before public dissemination. There is value in supervisors engaging with banks that have participated in supervisory SCRM exercises about the results prior to publication.

Key Design Choice:
Application of Results

Key feature	Specific Design Choice	Overview of Options
Applications	Prudential - Supervisory	<ul style="list-style-type: none"> Contributing to research and raising awareness about challenges and micro/macprudential risks. Supervisory engagement with individual financial institutions, including in supervisory colleges for cross-border institutions. For micro/macprudential recommendations by prudential authorities.
	Prudential - Regulatory	<ul style="list-style-type: none"> SCRM results can also be used to assess the adequacy of the prudential framework in light of the nature of risks identified, and potentially for regulatory interventions such as requirements for institution resilience building or adaptation.
	Industry Applications	<ul style="list-style-type: none"> Financial institutions can apply the results of SCRM exercises in multiple ways including: risk management; informing business strategy (lending decisions, portfolio-level targets and limits, setting business-wide climate-related targets and commitments); and as an input to disclosures.

At present, there is not a common international approach or set of principles to guide supervisors’ choices on the potential applications of the results of SCRM exercises, in particular their relationship to the prudential framework. The results of supervisory SCRM exercises could potentially be applied in number of ways; applications should reflect the high levels of uncertainty inherent in forward-looking analysis, the medium- to long-term nature of climate risks, and the interrelated and contingent nature of climate risks and socioeconomic responses to them, while also acknowledging the current levels of maturity of analytical approaches. While the NGFS has provided helpful suggestions on how supervisors can use climate scenario analysis, as a voluntary coalition the NGFS cannot develop global standards for the relationship between SCRM and prudential applications, including the relationship to banks’ internal capital adequacy assessments, supervisory macroeconomic stress testing or the firm-specific supervisory review process. The BCBS has indicated that it intends to conduct further work on the potential relevance of climate risks to the Basel framework in the areas of supervision, regulation and disclosure, including the use of scenario analysis as a supervisory tool, but it has not yet specified if it will deliver guidelines or best practices for supervisors.

The results of medium- or long-term climate scenario analysis exercises should be treated with caution and should not inform capital evaluations, particularly as there are more efficient tools available to incentivize and oversee banks’ management of longer dated risks. Medium-term exercises exploring the potential impacts of a disorderly transition can be useful to support supervisory dialogue with individual banks about their strategic plans and risk management, which is a critical step to catalyze banks’ internal activities to strengthen their responses to climate risks. However, there are conceptual issues with setting capital requirements - which are intended to be a cushion against unexpected losses that could occur

in the near-term⁴⁵ – for risks that could materialize in 10, 20 or even 50 years. In addition, the simplifying assumptions and degree of uncertainty in long-term scenario analysis makes such exercises generally indicative of risks, rather than sufficiently robust to inform prudential requirements for individual institutions. Finally, the introduction of near-term capital implications for medium- to long-term potential future risks could have a counterproductive impact on goal of an orderly transition with minimal risks to financial stability, for example by disincentivizing flows of transition finance to high-carbon sectors.

Nevertheless, climate scenario analysis is an important and powerful tool for medium and longer-term risk assessment. From a macroprudential perspective, long-term, high-level exercises can help contribute to horizon scanning, and raise awareness of systemic risks. The results of medium-term exercises could also inform assessments of the adequacy of the prudential framework in light of structural economic changes and system-wide risks identified. From a microprudential perspective, the supervisory review process is a very flexible tool that is specifically designed to be forward-looking and account for emerging risks, including setting expectations and incentives for firms to manage risks and returns over the long term and to ensure sound risk management and governance practices. Medium-term exercises exploring the potential impacts of a disorderly transition can be useful to support supervisory dialogue with individual banks about their strategic plans and risk management. The process of running the exercise and its results can provide information that enables banks to address knowledge and data gaps, and for strategic business decision-making, long-term risk management and client engagement to reduce potential firm-specific and system-wide climate-related risks.

While near-term climate stress testing could conceptually serve as an input to capital adequacy assessment, it would currently not be appropriate to do so, as the foundations are not in place with respect to knowledge, data and modelling. As the Basel Committee has observed: *“the uncertainty inherent in longer-dated assessments ... and the limited predictive power of historical observations to describe future climate-economic relationships ... render estimates of capital shortfall (or other measures of resiliency) less reliable than those of conventional stress tests employed by supervisors and banks to evaluate resiliency.”* Caution is required when using climate stress testing to assess resilience, and several key conditions would need to be met before climate stress tests could be informative to quantitative capital planning, including the following:

- **Data and tools need to mature** before climate risk drivers can be meaningfully used to assess current resilience in a quantitative way so that capital requirements remain carefully data-driven.
- **Further improvements in knowledge of financial risk transmission are also required**, including of potentially material second-round effects such as contagion effects within the financial system.

⁴⁵ Within the BCBS Pillar 1 framework, capital requirements are usually calibrated to cover losses (with a certain degree of confidence) that could crystallize over one year (in the case of credit risk) or shorter (e.g., in case of market risk). Supplemental, firm-specific capital requirements can be applied by supervisors under the Pillar 2 framework. Approaches to setting Pillar 2 differ across jurisdictions but most authorities refer to stress testing projections to assess a bank’s capital adequacy in relation to headwinds that could plausibly arise in the coming few years.

- **Stress test scenarios would need to involve risks that could plausibly crystallize in the near-term.** The nature and magnitude of the shocks considered in this type of exercise will differ from those in the other two reference approaches, although they should be derived from the longer-term science-based scenario narratives for analytical consistency. These may have a country-specific element (e.g., for near-term physical risks to banks' exposures).
- In the same vein, **data quality and model validation approaches constitute obstacles** to considering climate stress tests in an ICAAP or Pillar 2 context. A pragmatic and proportionate approach to data quality and model validation approaches would need to be developed, which recognize the unique challenges for this type of exercise. For example, shared protocols on techniques to proxy key missing data.

As previously discussed, supervisory SCRM exercises could be clearly differentiated from other prudential activities (including macro-financial stress testing), until data, tools and understanding have improved to the point at which results are meaningful and comparable across firms. Section 2.1 discussed some operational benefits to conducting supervisory SCRM exercises in a "regulatory sandbox" environment. From a conceptual perspective, it is also important for SCRM exercises to mature to a point at which results are more meaningful and comparable across participating institutions before they are used to inform firm-specific prudential responses.

3.3 Three Proposed Reference Approaches

Putting together the recommendations in the earlier sections, we propose that there could be three core Reference Approaches to be applied by supervisors and firms in SCRM exercises. These are visualized in Figure 7 below, and described in turn:

- a. **Long-term Macroprudential Horizon Scanning:** sizing potential risks to the economy and the financial system over the long term, arising from either a successful transition to a Net Zero, or a lack of action resulting in Hot house world;
- b. **Medium-term Firm-level Assessment:** exploring the dynamics of medium-term risk crystallization within the financial system;
- c. **Stress Testing Climate Risk Drivers:** testing for near-term vulnerabilities to financial institutions' safety and soundness arising from the crystallization of severe risks over the business planning horizon of approximately 1 to 5 years.

Figure 7: Summary of Main Features of Three Reference Approaches

<i>Foundations and Design Choices</i>		Horizon Scanning “Sizing Future Risks”	Firm-level Assessment “Exploring the dynamics”	Stressing Climate Risk Drivers “Testing for Vulnerabilities”
Foundations	Climate Risk Horizon	Long Term 2050-2080+	Medium Term 2030-2040	Near-Term 1-5 Yr Horizon
	Tool	Climate Scenario Analysis	Climate Scenario Analysis	Climate Stress Testing
Key Design Choices	Scenarios	Focus on Orderly Transition & Hot house World (NZ50, NDC, CP) – oriented to 2050-80 endpoint	Focus on Disorderly Transition (DNZ, DT) vs. Orderly Transition (B2C) – oriented to 2030-40 endpoint	Severe but plausible scenarios (derived from NGFS) oriented to near-term financial resilience horizon
	Scope (Institutions, Financial risks, Geographic, Exposures)	System-wide view (banks, insurers, investors) to capture full set of transmission channels. Credit risks most relevant	Sectoral view to capture specific transmission channels and feedback effects. Credit, market and operational risks could potentially be investigated	Sector-specific – e.g. integration within existing stress testing approaches for banks. Can explore impact on specific risk stripes (e.g. credit, market, operational)
	Format and Specification	Supervisor or Firm-conducted, top-down scoping	Firm-conducted likely preferable, mix of top-down and bottom-up scoping	Firm-conducted using bank internal models, bottom-up scoping (e.g. sectoral level or deeper, where possible)
	Modelling Assumptions	Simplifying modelling assumptions required	Dynamic balance sheet/management actions accounted for as much as feasible	Static balance sheet, but qualitative overlay could be used to account for management actions
	Outputs	Aggregate measures of financial stability risks and qualitative	Firm-specific quantitative and qualitative outputs;	Firm-specific balance sheet and regulatory variables, and

<i>Foundations and Design Choices</i>	Horizon Scanning “Sizing Future Risks”	Firm-level Assessment “Exploring the dynamics”	Stressing Climate Risk Drivers “Testing for Vulnerabilities”
	information about perceptions or banking system responses. Estimates of regulatory metrics unlikely to be informative	cross-bank benchmarking can be informative	qualitative information
<p>Applications</p> <p>Supervisory</p> <p>Regulatory</p>	<p>Macroprudential risk identification and monitoring, awareness raising</p> <p>Regulatory applications not appropriate due to analytical scope and high level of uncertainty</p>	<p>Qualitative supervisory engagement (e.g. as part of Pillar 2 supervisory review process)</p> <p>Firm-specific regulatory applications not appropriate due to medium-term nature and high level of uncertainty.</p> <p>Could inform assessments of the adequacy of the prudential framework in light of medium-term risks identified</p>	<p>Qualitative supervisory engagement (e.g. as part of Pillar 2 supervisory review process)</p> <p>No near-term potential regulatory applications, due to early stage of methodological maturity.</p> <p>Potential future consideration in capital planning, but caution is required and important preconditions would need to be met first, including:</p> <ul style="list-style-type: none"> • Risk data availability • Development of tools/knowledge of financial transmission channels • Proportionate approach to data quality/model validation • Development of appropriate scenarios

The proposed Reference Approaches should not be considered as sequential or in any order of importance. Rather, they should be considered as a **series of blueprints** to ensure exercise design is in keeping with the analytical objectives and intended application of results. In some cases, a supervisor or firm may be able to select one Reference Approach to analyze the questions of interest. In other cases, more than one Reference Approach may be required to meet different objectives. Some supervisory exercises to date have included several analytical components to assess different questions, for example, a quantitative exercise to size potential risks and a qualitative survey to explore the firm's potential management actions (e.g. BoE (2021)).

Reference Approach 1: Long-term Macprudential Horizon Scanning

Summary: Many supervisory SCRM exercises to date have been oriented towards a 2050 climate risk horizon, with a view to assessing the potential impacts on the financial system and broader macroeconomy of a system-wide shift towards Net Zero, or the potential costs of the manifestation of dangerous levels of physical climate risks if the world heads towards 3 - 4°C of warming by 2100. Reference Approach 1 reflects this type of exercise.

Guiding Questions: Potential research questions that supervisors or firms could use this Reference Approach to explore include:

- *What are the potential costs of climate breakdown to the financial system and broader economy?*
- *How will achievement of Net Zero goals affect the financial system?*
- *What transmission channels require monitoring?*
- *How can the prudential toolkit be used to reduce long-term risks to the financial system, and what tools are likely to be most effective considering high levels of uncertainty?*

NGFS Scenario Application: This type of exercise should consider a number of the NGFS Phase II scenarios, applying them to examine potential impacts at 2050 and beyond. While all NGFS scenarios may be relevant, it may be most useful to compare the hypothetical 'best' and 'worst' case outcomes (in terms of reaching Net Zero, or facing a Hot house world), as this comparison is likely to deliver the clearest differentiation of the costs and benefits of near-term strategic action to align firms' business models and capital allocation with Net Zero goals. Potential NGFS Reference scenarios to consider may include:

- **Orderly transition - Net Zero 2050:** Useful to assess the potential long-term costs to the financial system of reaching a Net Zero world, as a hypothetical counterfactual to 'worst-case' outcomes as specified by the Hot house world scenarios.
- **Hot House World - Nationally Determined Contributions:** Useful as an alternative to, or comparison with, the 'Current Policies' scenario to assess potential worst-case outcomes, by envisioning a world with limited additional policy action.
- **Hot House World - Current Policies:** Useful to assess the potential worst-case outcome of a lack of additional policy action, leading to high physical risks, damages, and broader macroeconomic costs.

Scope: Considering the high uncertainty inherent in looking out over decades, this type of exercise should be oriented to delivering high-level insights on potential system-wide impacts. A cross-sectoral scope can be beneficial to explore a broad suite of risk transmission channels. For jurisdictions that are the home authority to a large number of internationally active banking groups, a broad geographic scope (considering banking groups' exposures in a range of countries) can help broaden the view of where concentrated risk exposures may exist. Over very long-term horizons, it is likely to be most informative to assess credit risk which is informed by longer-term characteristics and banking book composition.

Format and Modelling Assumptions: This type of exercise is best done in high-level way that favors breadth of analysis – such as taking a cross-sectoral view to capture the full set of transmission channels – over excessive precision. Analysis underlying these exercises may be conducted either by supervisors or by firms. Modelling assumptions may be comparatively less complex to deliver a stylized view of potential future outcomes. For example, it may be appropriate to assume that firms hold their balance sheets 'static' to size maximum potential aggregate risks. Nevertheless, it may also be informative to explore a dynamic balance sheet assumption to account for potential changes in bank positions, particularly in a Net Zero 2050 scenario. While also a valid choice, a dynamic balance sheet assumption is extremely difficult to apply in practice today over a multi-decadal time horizon.

Outputs: This type of exercise can yield directional results on potential aggregate risks at the macroeconomic and financial system level. Quantitative outputs could include estimates of exposures, appropriately reflecting levels of uncertainty, but estimates of regulatory ratios are likely to be less informative. Qualitative outputs can be useful for supervisors to understand how firms are considering potential impacts and implications of climate-related risk outcomes for business strategies.

Applications: For supervisors, this type of exercise can help inform long-term risk scanning and assessment of risk transmission channels that may warrant monitoring. For firms, such analysis can help elucidate the potential 'worst case' outcomes facing their portfolio and business model if strategic adaptations are not implemented, thereby informing what types of adaptive measures may be necessary over time. Considering the long-term nature of analysis, this type of exercise is unlikely to ever be an appropriate tool to directly inform prudential requirements for individual institutions.

Reference Approach 2: Medium-term Firm-Level Assessment

Summary: Looking forward on the path to Net Zero by 2050, the next key transition milestone facing the global economy is to achieve a 50% reduction in CO₂ emissions by 2030 (relative to 2010 levels). Assessment of the dynamics of the transition should therefore concentrate on this medium-term timeframe. Firms and supervisors can both benefit from enhancing their understandings of how the dynamics of different transition pathways may impact individual institutions, and what potential financial stability risks could arise. This reference approach concentrates more on transition risks, recognizing that physical risks may exacerbate transition-related disruptions in certain sectors or jurisdictions.

Research Questions: Potential research questions that supervisors or firms could use this Reference Approach to explore include:

- *How might a rapid and disorderly transition to a low-carbon economy affect the future safety and soundness of financial institutions?*
- *How might firms' strategic responses affect risk dynamics?*

NGFS Scenario Application: This type of exercise should focus on the impacts of a disorderly transition over the near term (e.g., by 2030-2040), in order to explore in detail how economic and financial system disruptions could affect banks. Physical risks will also feature in this type of exercise; as the deviations between average temperature increases by 2030 under different Phase II Reference scenarios are comparatively small, a core set of assumptions regarding increasing chronic and acute risks should be applied recognizing that these risks are likely to increase significantly over time under a hot-house world scenario. Other design choices can help generate insights on how firms' capital allocation and strategic responses may either contribute to, or potentially exacerbate, disruption dynamics. An orderly transition scenario could be used as a hypothetical counterfactual. Potential NGFS Reference scenarios to consider may include:

- **Disorderly Transition - Divergent Net Zero:** Useful to assess the potential medium-term impacts of a rapid transition away from fossil fuels, and the impacts of divergent policies.
- **Disorderly Transition - Delayed Transition:** Useful for exercises with a broader geographic and sectoral scope, to consider the impacts of higher policy variation across regions.
- **(Counterfactual): Orderly transition - Below 2°C:** Useful to compare disruption dynamics, due to more moderate changes in technology change and low regional policy variation.

Scope: This type of exercise could be most feasibly targeted at specific sectors, for instance focusing on the banking sector, but could also be adapted to permit coverage of other types of financial institutions. Considering a 2030-40 timeframe, the core focus of the exercise would be on transition risks. In terms of financial risks, credit, operational and potentially market risk channels could be investigated; for example, disorderly transition may generate asset price fluctuations with implications for trading strategies. As far as permitted by data and modelling capabilities, granular exposure differentiation (in terms of corporate counterparties and sectors) could be helpful to enable exploration of market dynamics (e.g., the use of proxies for different types of strategic adaptations by counterparties).

Format and Modelling Assumptions: This Reference Approach is designed to consider the dynamics of the transition as it accelerates, in order to generate meaningful lessons for participating firms on the impacts to their balance sheets and business models. As such, this type of exercise should be firm-conducted, on the basis of the most granular data available and considering material exposures. For example, considering the complexity of counterparty level analysis at large scale, a balanced solution could be to start with a sectoral/sub-sectoral approach coupled with a deep dive at the counterparty level for the most important portfolios or exposures. This approach could be used also deliver preliminary insights on how

reallocation in line with banks' voluntary Net Zero commitments and related transition goals can affect financial system dynamics - primarily through the consideration of dynamic balance sheets over a period of the transition scenario. Recognizing that methodological approaches to consideration of balance sheet, strategic, and counterparty dynamics are at an early stage, narrative approaches can also be valuable to help infer directional trends in firms' strategies.

Outputs: This type of exercise could involve a range of different quantitative and qualitative metrics. Alignment metrics can be helpfully considered to inform modelling assumptions, such as dynamic balance sheets. The impacts of a disruptive transition on firms can be usefully expressed in a range of 'climate-adjusted' mainstream regulatory metrics, such as future loss given default, however this should be indicative and not for purposes of informing regulatory interventions. It can be useful for supervisors to benchmark results across banks in order to provide contextual feedback to individual institutions.

Applications: This type of exercise can be useful to inform macro and micro-level supervisory risk analysis. Bank-level results can be discussed between the bank and its home supervisor, and (subject to relevant information sharing protocols) also discussed within supervisory colleges for cross-border banks. Given the nature of this type of exercise and its results, which are inherently highly uncertain, the results are more informative for banks' long-term strategic decision making and qualitative supervisory engagement than to inform prudential requirements such as solvency or liquidity requirements. From a macroprudential perspective, long-term, high-level exercises can help contribute to horizon scanning, and raise awareness of systemic risks. The results of medium-term exercises could also inform assessments of the adequacy of the prudential framework in light of structural economic changes and system-wide risks identified.

Reference Approach 3: Stress Testing Climate Risk Drivers

Summary: This Reference Approach most closely relates to mainstream macro-financial stress testing, with a view to assessing the potential impacts of climate risks on the safety and soundness of financial institutions over the near-term financial resilience and business planning horizon of approximately 1 to 5 years.

Research Questions: Potential research questions that supervisors or firms could use this Reference Approach to explore include:

- *How would near-term crystallization of climate stress event(s) affect financial markets and firms?*
- *Will banks be able to withstand stresses to the balance sheet?*
- *What types of prudential interventions may be required to control for potential risks to safety and soundness of institutions?*

NGFS Scenario Application: Considering the near-term orientation of a climate stress test, and links to traditional supervisory time horizons, this type of exercise would be based on a set of severe but plausible scenarios oriented to near-term financial shocks. These should be derived from the NGFS scenarios for analytical consistency, but may require additional

specification and adaptation to reflect a severe enough shock to present a near-term financial stability stress event. One example of this type of adaptation is in the BoE (2021) exercise, which considers an especially severe GDP shock underlying a ‘Minsky Moment’ scenario associated with a disruptive transition⁴⁶. Other scenarios that could be considered in this type of exercise could involve a low-probability, high-impact physical risk shock, such as a series of correlated or contemporaneous climate-related natural disasters.

Scope: This exercise would involve a select group of key financial institutions (e.g., the major banks in a jurisdiction), which would be subject to mainstream financial resilience stress testing requirements. A select set of specific physical or transition risk impacts in key sectors would be assessed at a high level of granularity for impacts on the main financial risk stripes, such as credit, market and operational risk. It is possible to prioritize a certain financial risk stripes based on materiality or modelling capabilities – for example, focusing first on credit risk.

Format and Modelling Assumptions: This type of exercise should be firm-conducted and is likely to rely on adaptation or application of a bank’s internal models. The exercise is likely to rely on exposure-level and counterparty-level data, which makes it intensive and complex to undertake. For these reasons, climate stress testing is still a nascent field. A static balance sheet assumption is appropriate for examining the impact of near-term shocks, but a qualitative overlay is informative to understand the bank management actions or other mitigants that could reduce the stress impact over the time horizon of the exercise.

Outputs: Firm-specific balance sheet information would be the primary output. As this type of exercise is most aligned to mainstream stress testing, some outputs could be expressed as financial regulatory variables (or proxies thereof). Qualitative information is also informative to understand challenges with the exercise, and a bank’s proposed response to the scenario results.

Applications: Due to the early stage of methodological maturity, it is not appropriate to apply the results of climate stress testing in a prudential regulatory context. As discussed in Section 3.2, conceptually, one day, this type of exercise may be able to inform consideration of climate risks in a capital planning context but, as recognized by the BCBS⁴⁷, caution is required and several conditions would need to be met, which are unlikely to be met in the next few years. These include the following non-exhaustive set of conditions: data and tools need to develop; improvements in knowledge of financial risk transmission are required; relevant stress test scenarios would need to be developed to reflect risks that could plausibly crystallize in the near-term; a pragmatic and proportionate approach to data quality and model validation approaches would need to be developed.⁴⁸ Before that point, it may be possible to refer to the results of climate stress tests as part of qualitative supervisory engagement.

⁴⁶ BoE (2021).

⁴⁷ BCBS 2021.

⁴⁸ See Section 3.2 for a fuller discussion of these necessary conditions.

>> Key Messages and Recommendations in Section 3:

- There are key differentiating factors which can shape the structure of an SCRMM exercise: climate risk horizons, objectives and analytical questions, and tools. There are important conceptual and practical differences between climate scenario analysis and stress testing, which affects their potential relevance in a prudential context.
- A large number of design choices need to be made before undertaking an SCRMM exercise. Considering the state of maturity of SCRMM approaches, some design choices warrant special consideration and may benefit from further development.
- Scenarios: NGFS Phase II Reference Scenarios should be leveraged as far as possible by supervisors and industry, further development should reflect experience with the scenarios over time but could focus on how scenarios should be adapted for local contexts and the extent to which additional scenarios may be needed, e.g. to reflect firm-specific characteristics.
- Scope: Supervisors and firms could collaborate to develop common definitions of climate-sensitive sectors, common approaches to improve counterparty-level analysis, and to explore cross-sectoral risks within the financial system.
- Format and Specification: Supervisor-conducted and firm-conducted exercises can both play a role in supervisory SCRMM exercises, depending on the objectives of the exercise and distribution of technical capabilities. There would be value in public-private collaboration to develop approaches for proxying key variables for use in supervisory exercises.
- Modelling Assumptions: Supervisors and firms should collaboratively develop approaches for the incorporation of dynamic balance sheets, strategic adaptations, and counterparty behavior in medium-term exercises.
- Outputs: The orientation of an SCRMM exercise should shape the choice of metrics and variables used to express results. Exercise outputs should be distinguished from public disclosures of the results of SCRMM exercises – given the sensitivity of SCRMM exercises, an appropriate degree of disclosure of the aggregate results to the broader public would need to be carefully considered.
- We propose three core Reference Approaches as a framework for aligning the key design choices inherent in SCRMM exercises – the scenarios, scope, the format and specification, key modelling assumptions, and outputs – with different microprudential, macroprudential, and strategic objectives and applications.
- The results of climate scenario analysis exercises should be treated with caution and should not inform capital evaluations, particularly as capital is not the right tool to manage such longer-term risks. However, climate scenario analysis is a potentially powerful tool for medium and longer-term analysis such as horizon scanning and exploring the impact of alternative transition and physical risk scenarios on financial stability.
- Due to the early stage of methodological maturity, it is not appropriate to apply the results of climate stress testing in a prudential regulatory context. Conceptually, it is possible to develop ways to incorporate climate risk drivers into a stress test of bank resilience, however, this is only appropriate to assess a bank's near-term exposure to climate risks that could crystallize in the coming years. However, as recognized by the BCBS, caution is required and several conditions would need to be met before stress testing should inform capital planning or requirements, which are unlikely to be met in the next few years.
- Supervisory SCRMM exercises should be differentiated from other prudential activities or applications until data, tools and understanding have improved to the point at which results are meaningful and comparable across participating financial institutions.

4. Recommended Actions for Cross-jurisdictional Alignment and Development

Cross-jurisdictional alignment of SCRM exercises should be a near-term priority for prudential authorities, aided by the global standard setting bodies. Greater cross-jurisdictional alignment would deliver a triple-win: it would bring greater consistency to the results of exercises; support the development of common approaches to key modelling and data elements; and drive greater prioritization of investments in technical capacity by participating financial institutions. Multiple options exist to strengthen coordination, some of which are more appropriate in the near-term given the current maturity of SCRM, and some of which could be explored over the next 2 to 5 years.

Recommended near-term priority actions (approximately the next 1 to 2 years)

1. The BCBS could develop an initial set of Global Principles and/or Sound Practices for climate scenario analysis and stress testing.

The BCBS has produced “Stress Testing Principles”⁴⁹ for supervisors and large internationally active banks in relation to macro-financial stress testing, which have become an important part of the supervisory framework since the global financial crisis. Global principles for the conduct of supervisory climate scenario analysis exercises, or climate stress testing, could help align emerging supervisory approaches across jurisdictions. The BCBS is well-placed to provide guidance, particularly with regards the relationship with the prudential framework. Other aspects that BCBS Principles might cover could include the frequency of supervisory SCRM exercises, scope of application of national exercises, information sharing within supervisory colleges and protocols to standardize data proxying and model assurance.

Separately, BCBS Sound Practices on this topic could guide financial institutions across the world with different levels of experience with SCRM so that they focus their efforts and investment in the most productive directions. These could build upon the recent helpful analysis by the BCBS regarding climate-related financial risk drivers⁵⁰ and measurement methodologies.⁵¹

While it would be helpful to clarify some aspects sooner rather than later to support alignment across jurisdictions, any BCBS Principles or Sound Practices would need to evolve and be refined over time on the basis of shared public/private experience, including with supervisory SCRM exercises that are currently underway or planned in the coming years.

2. Supervisors should discuss the findings of SCRM analysis in supervisory colleges. The BCBS can support national authorities and supervisory colleges by gathering information about planned supervisory exercises.

As discussed in Section 2.4, above, sharing the results of SCRM analysis within a cross-border bank’s college of supervisors could be highly beneficial. In general, it is more efficient for

⁴⁹ Basel Committee on Banking Supervision, “[Stress testing principles](#),” October 2018.

⁵⁰ Basel Committee on Banking Supervision, “[Climate related risk drivers and their transmission channels](#),” April 14, 2021.

⁵¹ BCBS 2021 (April).

exercises to be conducted at consolidated group level only and for the relevant findings to be shared with host supervisors – including of subsidiaries – within supervisory colleges. Potential future BCBS Principles could encourage transparency within supervisory colleges, as well as an emphasis on group-level exercises set by the consolidated home supervisory authority. The BCBS could also support national prudential supervisors and supervisory colleges by collecting information from its members on their plans for upcoming SCRMs exercises and sharing the forward schedule for awareness and planning purposes.

3. National prudential authorities should apply the NGFS Reference Scenarios in their own exercises, and financial institutions should refer to them as part of their internal scenario analysis exercises.

As discussed, the NGFS Reference Scenarios are a powerful, science-driven baseline for SCRMs analysis. The FSB has recently commented that *“further deepening of scenario analysis, making use of NGFS scenarios, will be important”*⁵². As a next step, it will be beneficial for there to be greater alignment around the NGFS scenarios particularly in supervisory exercises. It will drive greater transparency around this pivotal aspect of scenario-based exercises and contribute to the development of experience and trust with SCRMs exercises, including between supervisors in different jurisdictions. The NGFS continues to develop and evolve its Reference Scenarios over time, which is highly valuable and can be informed by feedback from supervisors and financial institutions as they seek to apply them more widely. To ensure ease of use, transparency and clarity on developments, the NGFS could consider developing a public ‘change log’ to indicate updates to future versions of the scenarios.

4. Continued and expanded development of pre-competitive industry collaboration, and public-private collaboration, to address data gaps.

As discussed in Box 1, the availability and quality of data is one of the leading challenges faced by banks globally when they undertake SCRMs analysis as well as broader risk management, and is therefore a key area where work is needed within the financial industry, as well as through collaborations with the public sector. In terms of industry collaboration, opportunities for pre-competitive information sharing via data pooling or open-source data platforms could be enhanced. There are some existing examples of this, such as the OS-Climate initiative⁵³ which is developing a global data compendium and data commons as part of its open-source platform. There are good examples from other fields, such as the OR-X database for operational risk losses.⁵⁴

Client data, for example regarding corporate transition plans, will continue to be an important source of information for the banking industry (see Box 1). Efficiencies could be found if all banks used the same templates and questionnaires for gathering climate-related information from their clients, including corporates, sovereigns and other financial institutions. Open-source templates developed within the banking industry, potentially in collaboration with the

⁵² Financial Stability Board, [“FSB Roadmap for Addressing Climate-Related Financial Risks,”](#) July 7, 2021. Hereafter referred to as “FSB 2021.”

⁵³ [OS-Climate](#).

⁵⁴ [OR-X](#).

public sector, could standardize this form of data gathering and also reduce the burden for banks' counterparties as there would be greater standardization and more predictability in information requests made of them. Equally, if supervisory authorities collect data on individual companies for the purposes of their own supervisor-conducted analysis, it would be efficient if they are able to share such databases with supervised institutions.

In general, enhanced climate reporting by corporate entities, including for unlisted companies in carbon-intensive sectors, would greatly support SCRM and broader risk management by financial institutions. In addition to mandating corporate disclosures relevant to climate-related risk analysis, public authorities could increase ease of access to disclosed information through public, open-source databases. For example, the European Union (EU) has consulted on the establishment of a European Single Access Point (ESAP) which is aiming to make available in one place EU companies' public financial and sustainable investment-related information.⁵⁵

While the general availability and quality of data improves, banks will need to continue to rely to some extent on proxies in order to run SCRM exercises. While necessary, this is an aspect of SCRM exercises that can reduce the comparability of firm-specific outputs and make it difficult to derive an aggregate picture or peer comparisons in supervisory exercises. It would be highly valuable for the public and private sectors to work together to develop commonly accepted approaches for proxying key variables, which are feasible to produce and accepted by supervisors within supervisory SCRM exercises. For example, commonly defined sector averages for CO₂ intensity could be agreed to fill some data gaps where emissions are not available or not complete for a corporate counterpart. This could also be an area covered by future BCBS Principles for climate scenario analysis and stress testing.

5. Collaborative work is required to explore emerging aspects of SCRM practice and identify leading approaches

Beyond data, further collaborative work is required to explore emerging aspects of SCRM practice, including complex analytical questions. Within the industry, potentially in supervisory-facilitated workshops, banks could share best practices and analytical insights. In the context of supervisory SCRM exercises, supervisory feedback to individual institutions after cross-firm exercise could help firms to benchmark their approaches with respect to their peers with the aim of promoting leading practices and identifying common challenges. While it will take time, convergence towards standards for key metrics, including financed emissions accounting, should eventually deliver a public good in terms of risk measurement and standardization.

Recommended medium-term actions (approximately the next 2 to 5 years)

Over the medium-term, cross-jurisdictional horizon scanning exercises could be enhanced through top-down work undertaken by institutions such as the FSB, and by a potential future centrally-coordinated cross-jurisdictional SCRM exercise.

⁵⁵ European Commission, "[Targeted consultation on the establishment of a European single access point \(ESAP\) for financial and non-financial information publicly disclosed by companies](#)," January 20, 2021.

6. The FSB could develop its capacity for cross-sectoral and cross-jurisdictional climate risk horizon scanning.

The FSB has already undertaken significant analysis regarding the implications of climate change for financial stability and has identified channels for risk amplification within the financial system, including across borders.⁵⁶ The FSB is well-placed to conduct a top-down, macroeconomic SCRM exercise at the global level to investigate the potential risk transmission channels between different parts of the financial system (banks, insurers, asset managers) and across jurisdictions. As discussed in Section 3, this could be more akin to a stylized, horizon scanning exercise for which a long risk time horizon would be valuable. The outputs could be a useful complement to industry and national supervisory efforts to identify and quantify the potential materiality of certain transmission mechanisms from the perspective of financial stability. The FSB could start to lay the groundwork for this type of approach now with a view to conducting it in the next 1-2 years.

This recommendation aligns with the recently published FSB Roadmap for Addressing Climate-related Financial Risks⁵⁷ in which the FSB lays out steps to develop a *“solid basis for incorporation of regular monitoring and assessment of climate-related financial risks into overall risk financial risk monitoring,”* in support of efforts to *“integrate climate-related risks in its surveillance framework for global financial stability risks”* between now and 2023.

7. In future, there may be a role for coordinated cross-jurisdictional SCRM exercises, for example undertaken by the BCBS for the banking sector.

At present, SCRM exercises are still in a developmental and exploratory phase. Banks are facing considerable pressure to develop and apply this new type of SCRM tool at the same time as generally deepening their climate-related expertise, and many are being required to participate in supervisory exercises on top. It is therefore not the right moment for additional, non-essential supervisory exercises. Nevertheless, in future - when knowledge, data, tools and capacity are greater - there could be advantages to the development of a carefully designed centrally-coordinated SCRM exercise involving internationally banks located in different jurisdictions. This could be conducted in a top-down way by the BCBS based on data inputs from a sample of large banks, such as Global Systemically Important Banks (G-SIBs). The objective could be to specifically examine common risks across jurisdictions, or spillovers, that could potentially be the most material to the stability of the global banking sector⁵⁸. In this way, such an exercise could draw on the findings in terms of key risks that will have emerged from preceding national exercises. A centrally-coordinated exercise could fulfil a specific function and support prioritization in any national exercises, and would remove one rationale for authorities to include local subsidiaries of global banks in national exercises. Ideally, the exercise would be designed in a way that derives insights for participating banks and supports their internal risk management.

⁵⁶ FSB 2020.

⁵⁷ FSB 2021. Page 7

⁵⁸ The previous long-term recommendation to the FSB would gather information from a cross-sectoral perspective beyond the banking system.

Before preparing such an exercise, the BCBS and member authorities would need to address several practical considerations about its design:

- It would be important that any such centrally-coordinated exercise builds on, and does not duplicate, prevailing national exercises. For example, by referring to the same scenarios (chosen from the NGFS Reference Scenarios) and by only requesting data that was already used as the basis of national SCRM exercises in major jurisdictions.
- Similarly, the sequencing of any cross-jurisdictional exercise should be carefully considered, for example it could be a low frequency analysis (e.g. every 5 years) to complement rather than coincide with any other local SCRM exercises in major jurisdictions.
- Importantly, the BCBS would need to account for different data availability and technical capabilities across jurisdictions in the exercise design. This would suggest that a BCBS-conducted exercise drawing on other data sources than may be available to all participating member banks could be preferable.
- Consideration would need to be given as to the disclosure of the results. There would be value in greater sharing among the participating institutions, but an appropriate degree of disclosure of the aggregate results to the broader public would need to be carefully considered.

An alternative exercise that the BCBS could consider at a later date would be a type of hypothetical portfolio exercise to identify divergences in practice and support model benchmarking and data harmonization. The results of such an exercise could be used to accelerate progress and increase harmonization where helpful, but should not be used to constrain diversity of thought and experimentation in terms of assessing climate-related risks. In advance of any potential future centrally-coordinated exercise involving data from the banking industry, it would be important to allow sufficient industry consultation in the planning phase to maximize the data quality and overall benefits of the exercise.