CFRF CLIMATE FINANCIAL RISK FORUM

CGFI UK Centre for Greening Finance & Investment

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LEARNING FROM THE 2021/22 CLIMATE BIENNIAL EXPLORATORY SCENARIO (CBES) EXERCISE IN THE UK: SURVEY REPORT

Collaboration between the UK Centre for Greening Finance and Investment and the Climate Financial Risk Forum, March 2023

Contents

This chapter represents the output from the cross-industry Scenario Analysis Working Group of the Prudential Regulation Authority and Financial Conduct Authority's Climate Financial Risk Forum in collaboration with the UK Centre for Greening Finance and Investment and the University of Oxford. The document aims to promote understanding, consistency, and comparability by providing guidance on how to use scenario analysis to assess financial impact and inform strategy/business decisions.

This CFRF guide has been written by industry, for industry in collaboration with academic researchers. The recommendations in this guide do not constitute financial or other professional advice and should not be relied upon as such. The PRA and FCA have convened and facilitated CFRF discussions but do not accept liability for the views expressed in this guide which do not necessarily represent the view of the regulators and in any case do not constitute regulatory guidance.

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This paper was written by the UK Centre for Greening Finance and Investment (UKCGFI) in collaboration with the Climate Financial Risk Forum (CFRF) Scenario Analysis Working Group, which includes asset managers, banks, insurers and service providers to the financial industry. The UKCGFI is a national centre established to accelerate the adoption and use of climate and environmental data and analytics by financial institutions internationally.

The UKCGFI research team was led by Nicola Ranger (Oxford) including Mark Bernhofen (Oxford), Hannah Bloomfield (Bristol), Ben Caldecott (Oxford), Iain Clacher (Leeds), Rachel James (Bristol), Juan Sabuco (Oxford), Gireesh Shrimali (Oxford) with inputs from Moritz Baer (Oxford), Paul Bates (Bristol), Abhi Desai (Imperial College), David Kampmann (Oxford), Iva Koci (Imperial College), Jason Lowe (Leeds), Jacob Schumacher (Oxford), Len Shaffrey (Reading), Rowan Sutton (Reading), Kevin Tang (Oxford), Ralf Toumi (Imperial College), Mike Wilkins (Imperial College).

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Executive summary

The UK Centre for Greening Finance and Investment (UKCGFI) and the Climate Financial Risk Forum (CFRF) worked together over 2022 to gather and synthesise the lessons from the process of the Bank of England's Climate Biennial Exploratory Scenario (CBES), both to capture the learning for UK FIs and to share this internationally. Information was gathered from 37 survey respondents, across 15 of the 18 CBES participants, and 12 interviews over an eight month period. The findings were validated at two workshops with CBES participants in January 2023.

The central finding is strong evidence of enhanced capacity and a positive impact of the CBES exercise on participating FIs, including greater awareness of climate risks and opportunities and greater integration of climate risks into risk management. Respondents were positive about the impact of CBES, despite the inevitable challenges of undertaking this new type of analysis. The survey results clearly show high positive impacts of CBES in terms of awareness and engagement at Board and C-Level, training of staff, enhanced capability throughout the organisation, and greater integration of climate risks into institutional risk management, credit risk analysis, and strategy. Challenges were found over resource and data requirements.

Lower impacts at the client-facing level are reported (e.g. in terms of client dialogue and data collection) suggesting that, while not an explicit objective of the CBES exercise, the real-economy impact of CBES may have been more limited.

The design of the exercise was seen as broadly adequate given the objectives of CBES, and appropriate to the capacity of the market and availability of data at the time the exercise was designed. Choices over the design of the exercise necessitated trade-offs, such as the static balance sheet assumption and the scope of the risks included. The feedback from respondents provides a useful perspective of whether those design choices meant that the design was suitable for the stated objectives and how results can be interpreted. Agreement on the suitability of the design of the exercise was strongest for the objective to enhance the management of climate-financial risks; almost 60% of respondents strongly agreed with this. For sizing financial exposures and understanding challenges to business models (the two other of the three objectives) around 20 – 35% strongly agreed with the suitability of the design of the exercise and only around 12 – 16% of respondents disagreed. Challenges identified by respondents included, for example, that the static balance sheet may have led to overestimates of some risks, while missing risk transmission channels and drivers led to underestimates elsewhere. These issues were understood by the Bank of England at the time of the design and the choices deemed necessary to ensure the consistency, practicability and credibility of the exercise. Nonetheless, the views of participants provide important input on interpretation of the results, directions for future exercises and where efforts to develop scenarios and methodologies can be most beneficial.

CBES delivered many important lessons for future climate scenario analysis. Future work should focus on resolving these issues and closing gaps in potentially material sources of risk that were not fully captured in the first exercise. Static (fixed) balance sheet assumptions and counterfactual adjustments were raised by many respondents as issues that limited interpretation and where further methodological development is needed. Respondents highlighted several missing risk areas: greenwashing, supply-side shocks, indirect physical risks, rapid shifts in government policy, compounding risks, geopolitical risks, and second-order macroeconomic feedback effects. Respondents recognised the difficulties in filling these gaps given currently available information. These findings are broadly consistent with the

recent work of the Financial Stability Board (FSB) and the Network of Central Banks and Supervisors for Greening the Financial System (NGFS)[1].

Despite the challenges and trade-offs, many of the CBES participants stressed that the CBES provided a good first step given the need to build organisational capability across the sector and limitations in data. It is also important to note that the CBES was part of a landscape of wider supervisory expectations and regulations that collectively ensure the resilience of the UK financial system to climate change, including in particular SS3/19. The survey produced many detailed recommendations for regulators for future exercises and information on the need for further research, data and scenario development (see Recommendations report).

The central goal of this research was to capture and synthesise the learning from the CBES for UK FIs but also to share internationally. Many of the findings will have read-across to other Central Banks and Supervisors. The design and operational challenges were not unique to the UK and through sharing these openly we hope that we can assist other countries in advancing their own climate resilience objectives.

[1] https://www.fsb.org/wp-content/uploads/P151122.pdf and https://www.fsb.org/2022/11/climate-scenario-analysis-by-jurisdictions-initial-findings-and-lessons/.

Introduction

Aims and objectives

The UK Centre for Greening Finance and Investment (UKCGFI) and the Climate Financial Risk Forum (CFRF) worked together over 2022 to gather and synthesise the lessons from the process of the Bank of England's Climate Biennial Exploratory Scenario (CBES) through a series of surveys and interviews with appropriate individuals involved in the process from the CBES participating firms, with validation through workshops in 2023.

The objectives of the project were threefold:

- **Inform the development of future data, metrics and scenarios to better support financial institutions (FIs) and Central Banks and Supervisors (CB&Ss) in their scenario analysis and stress testing work**. The project aims to gather learning from CBES participants on how data and scenarios were used as part of the CBES process, where the gaps and challenges were, and how these where overcome. From this, a series of recommendations for wider FIs and CB&Ss, as well as the scientific and data communities, to enhance the availability and use of information for scenario-analysis have been proposed.
- **Strengthen capability of UK and global financial institutions in scenario-analysis and stress testing, through capturing and sharing the lessons from the CBES participants.** For example, learning how the participating financial institutions incorporated the CBES scenarios within their existing processes, what capabilities needed to be built, which data sources they found most helpful and where they saw the gaps in their capability and how this could be enhanced. Lessons are used to make recommendations on how organisational capabilities could be built over time, e.g. through peer-networks like CFRF, and shared in the UK and globally through a series of reports, articles and workshops.
- **Inform the design of future scenario and stress testing exercises by CB&Ss internationally to maximise their impact.** The project aims to gather evidence on what impact CBES had on long-term capability for climate scenario analysis and stress testing within the participating FIs and gather feedback to inform future exercises.

The project took a four stage approach: firstly, initial informal interviews (March-April 2022); secondly, an online survey supported by GARP (June-August 2022); thirdly, formal interviews (August-September 2022); and finally, refining the recommendations through consultation workshops with CBES participants and CFRF members (January 2023). We note that this approach means that the findings are one-sided, speaking to the experience of those that had to complete it. This was deliberate as this voice is not captured elsewhere, but we have tried to balance this through including information from the Bank of England itself to explain why certain design choices were made.

It should be noted that the CBES survey results were published by the Bank of England before the online survey was opened (in late May 2022) and after the initial informal interviews; this means that survey respondents will have had a chance to review the Bank of England's interpretation of the results and their lessons learnt before the survey was completed. It is likely that this will have influenced the responses. It is also notable that the shocks to energy and food prices related to the crisis in Ukraine began to really bite during the later part of the survey period and the period of the formal interviews. These events may have influenced the dialogue around scenarios, for example, creating a greater recognition of the potential importance of

extreme 'shock' scenarios and this may be reflected in the survey (and interview) findings. All the interviews were completed before the UK fiscal event in Autumn 2022.

This paper focuses on the findings of the survey and brings in some initial perspectives from the analysis of interview findings. The paper presents the lessons synthesised by the UK Centre for Greening Finance and Investment. An initial 'strawman' of recommendations for different stakeholder groups was developed based upon these lessons and shared with CBES participants and CFRF members. The recommendations were refined through consultation workshops. The recommendations report and workshop reports are available on the CGFI website (cgfi.ac.uk).

Background[2]

This section provides background information on the CBES exercise. This description is taken close to directly from the Bank of England communications to reduce risks of misinterpretation, ambiguity, and miscommunication. Please refer to the Bank of England online resources on the CBES for full and official information.

The Bank of England (BoE) defined the objectives of the CBES exercise as[3]:

- Present a fully coherent set of scenarios that could be used to assess climate risks facing key UK firms.
- Assist participants in enhancing their management of climate-related financial risks, consistent with expectations set out in Supervisory Statement 3/19, including embedding these risks in business as usual risk management, engaging counterparties to understand their vulnerability to transition and physical climate risks, and encouraging boards to take a strategic, long-term approach to managing these risks.
- Size the financial exposures of participants and the financial system more broadly to climate-related risks.
- Understand the challenges to participants' business models from these risks; and gauge their likely responses and the implications for the provision of financial services.

The BoE described that these aim support both the PRA's objectives to ensure the safety and soundness of firms and to contribute to the protection of insurance policyholders, as well as the FPC's objective to enhance the resilience of the financial system. Notably, the CBES also supports the FPC's objective support the Government's wider economic policy, which includes ensuring that the financial system is able to support the transition to a net-zero economy. Table 1 summarises the financial institutions (FIs) that participated in the exercise.

[2] Source: Bank of England (2022) Results of the 2021 Climate Biennial Exploratory Scenario (CBES)
[3] CBES 'Key Elements' published in June 2021

Large UK banking groups and building societies	Large UK life insurers	UK general insurers	International general insurers
Participation:			
Barclays HSBC Lloyds Banking Group Nationwide Building Society NatWest Group Santander UK Standard Chartered	Aviva Legal & General M&G Phoenix Scottish Widows	Allianz Holdings plc (UK entities only) Aviva AXA (UK entities only) Direct Line RSA (UK entities only)	AIG (UK entities only) Society of Lloyd's (Ten selected Syndicates)
Coverage in key markets:			
Around 70% of UK bank lending to UK households and businesses.	Around 65% of the UK life insurance market by asset size. A range of business models (annuities, with-profits, unit-linked).	Around 60% of the UK general insurance market by Gross Written Premium.	The ten selected Syndicates account for around 40% of the Society of Lloyd's property and liability insurance market by premium.

Table 1: Financial institutions that participated in the CBES 2021/22

The focus of the exercise was on assessing transition and physical-climate related financial risks to the UK. To do this, the CBES included three scenarios. The exercise considered two possible routes to net-zero UK greenhouse gas emissions by 2050: an 'early action' scenario and a 'late action' scenario. A third 'no addition action' scenario explores the physical risks that would begin to materialise if governments around the world fail to enact policy responses to global warming. These scenarios were not forecasts of the most likely future outcomes, but instead were intended to be plausible representations of three possible future outcomes, including climate policies, technological change and shifting consumer behaviour, as well as global temperature rise and its impacts. Each scenario was specified over a period of 30 years.

The CBES scenarios were based on a subset of the NGFS scenarios. The Bank of England explains that it expanded these by including additional risk transmission channels and variables, working with climate scientists, academics, and industry experts. The CBES results paper (May 2022) notes that since issuing the scenarios in June 2021, carbon prices have risen slightly, fuel prices are much higher in large part due to the Russian invasion of Ukraine, and the latest reports of the Intergovernmental Panel on Climate Change suggest that emissions will need to be reduced even more aggressively to prevent warming from exceeding 1.5C.

Given the focus of the exercise on driving improvements in risk management and understanding how firms may respond to the risks they could face, the BoE noted that the CBES incorporated some key differences in design relative to climate stress tests run elsewhere. The exercise required participants to make granular assessments of their largest counterparties; particular emphasis was placed on banks' and insurers' ability to evaluate the net-zero transition plans of their corporate counterparties; and the exercise focussed on participants' responses to climate risks to a greater extent. For banks, loss projections were focussed was on the credit risk associated with their lending activities, with an emphasis on detailed analysis of risks to large corporate counterparties. For insurers, the focus was on changes in the value of invested assets and the impact on insurance claims.

Loss projections for the CBES scenarios are based on the balance sheets of participants as they stood at the end of 2020 (i.e. the 'static balance sheet' assumption). As such, they represent an expectation of losses that might materialise if banks and insurers do not act to reduce the climate risks they face. This design feature was chosen explicitly by the Bank of England as it makes interpretation of the results more straightforward and allows a clear, separate focus on specific actions that participants might take in response to the scenarios and the risks to today's business model over the period of the scenarios. But the BoE noted that this is also likely to push projected losses upwards, as over the thirty year horizon of the CBES participants would likely be able to adjust their business models, and may reduce or mitigate some of the risks they face. This design trade-off was deemed necessary, based on the lessons learnt from 5-year solvency exercises, to ensure the consistency and credibility of the exercise[4].

Further design choices and trade-offs were introduced concerning the scope and severity of the CBES. The BoE made clear that the CBES would not cover all risks and this was a deliberate design choice. This was most notable in the traded risk space. Similarly for the intensity of scenarios, which were designed to meet the objectives.

Further information on the CBES data and scenarios is given on the BoE website[5].

Bank of England findings from the CBES

The Bank of England's results of the 2021 Climate Biennial Exploratory Scenario (CBES) were released in May 2022. The headline findings of greatest relevance to this report include:

- **Climate risks captured in the CBES scenarios are likely to create a drag on the profitability of UK banks and insurers**, particularly if they are unable to manage these risks effectively. Loss projections vary across participants and scenarios, but are equivalent to an annual drag on profits of around 10-15% on average. But there is substantial uncertainty around the true magnitude of these risks. And climate risks outside the scope of the CBES (such as trading losses for banks and mortality risk for life insurers) could be material.
- **Projections of climate losses are uncertain; scenario analysis is still in its infancy and there are several notable data gaps**. Due to the relative immaturity of firms' approaches and the complexity of modelling the impact of these risks, the uncertainty bands around projected losses are very large.
- **Major financial institutions in the UK have made good progress in assessing and managing climate-related financial risks, but there is much more to be done.** Banks have also made good progress in identifying their portfolios which may be most sensitive to climate risks, but face challenges in accurately quantifying the level of risk they are exposed to. Their overall ability to model climate risk is at an early stage. Few banks have developed in-house modelling capability, with many reliant on a small number of third parties. Insurers also noted numerous data challenges that they faced in estimating potential losses on their invested assets. In particular, data on companies' emissions, and their geographical locations and those of their supply chains, was incomplete. The ability to assess and model physical risks in the CBES varied across

[4] Without this, for example, FIs could inadvertently make assumptions that would 'assume away' the risks. This was a lesson learnt through 5-year exercises that would have been magnified through a 30-year exercise. An alternative approach would have constrained firms in other ways, which would have entailed other trade-offs

[5] https://www.bankofengland.co.uk/stress-testing/2021/key-elements-2021-biennial-exploratory-scenario-financial-risks-climate-change.

firms, largely reflecting their varying capability to modify existing models. The BoE identifies several examples of good practice from CBES responses.

- **The CBES has already helped drive improvements in scenario analysis**. The BoE reports that CBES has shown that UK banks and insurers are making good progress in some aspects of their climate risk management, and this exercise has spurred on their efforts further. But the Bank's assessment is that UK banks and insurers still need to do much more to understand and manage their exposure to climate risks.
- **The lack of available data on corporates' current emissions and future transition plans is a collective issue affecting all participating firms**. One recurrent theme across participants' submissions was a lack of data on many key factors that participants need to understand to manage climate risks. Another was the range in the quality of different approaches taken across organisations to the assessment and modelling of these risks.
- **In order to produce better estimates of climate risks in their portfolios, banks and insurers will need to prioritise investment in their climate risk assessment capabilities,** including their internal modelling and data capabilities and doing more to scrutinise data and projections supplied by third-party providers. The inability to capture appropriate and robust data in certain areas is a common limitation, which means many climate risks are only being partially measured. Examples include: the location of corporate assets to permit physical risk assessment, and a lack of standardised information about value chain emissions relating to corporate counterparties.
- **The Bank of England identified several lessons for the appropriate design and execution of future climate stress scenarios and exercises.** For example, allowing participants to exercise flexibility rather than being prescriptive in approaches to modelling, and asking them to liaise directly on climate risks with their counterparties has driven improvements in banks' and insurers' risk management approaches, and helped to expose data and modelling gaps. The Bank also learned that participants found it difficult to consider their responses to the CBES scenarios in depth, in part reflecting uncertainty about aspects of climate policy. This uncertainty meant participants had to make assumptions about the precise form such policy would take. Finally, the fixed balance sheet assumption has had both costs and benefits. Overall, the fixed balance sheet assumption may have pushed up projected losses.

Methodology

Our findings described in this report are based upon responses to our survey with the CFRF and GARP from 37 individual respondents across 15 of the 18 CBES participants. The respondents were split roughly 50:50 insurers (life and general) and banks and building societies. All results were fully anonymized as part of the process. The interpretation of the survey findings was validated through workshops in January 2023, which involved all CBES participants (i.e. more than those interviewed/surveyed).

Most participants surveyed had their portfolio predominantly balanced toward the UK, and around 30% US/Europe/Global Portfolio. More than 75% of respondents were based in risk-related or risk management functions within their organisation and 11% in Group Climate Change or Strategy departments. 55% of respondents were either leading the CBES response preparation for their organisation or holding responsibility as the senior

management function. The remainder (45%) were involved in providing technical inputs, including modelling, or overseeing risk analysis.

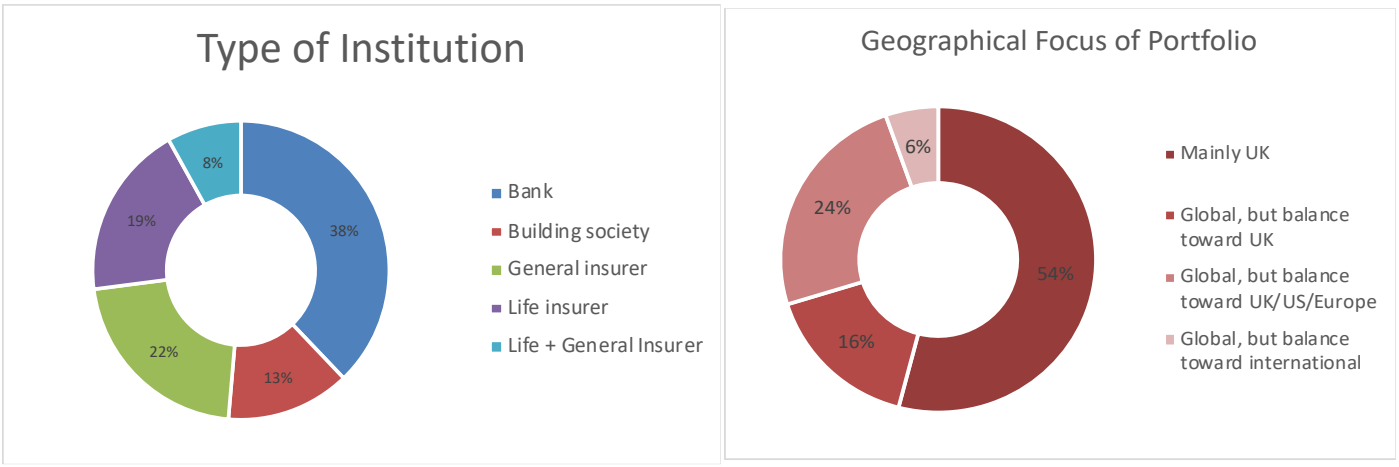


Figure 1: Types of institution and geographical distribution of their portfolios for the 15 responding institutions to the survey (out of a total of 18 CBES participants)

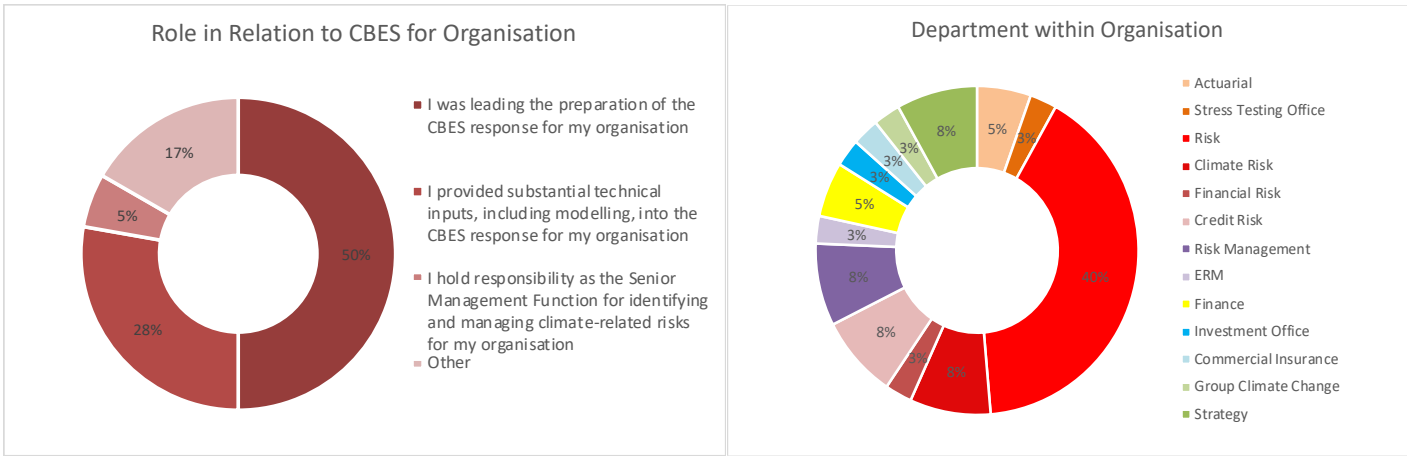


Figure 2: The roles and departments of the 37 respondents to the survey.

Finding 1: Impact and capability building

CBES implementation

For 8% of respondents, climate stress tests were a routine part of risk management before CBES (but 33% within internal processes). **Post-CBES more than half of respondents report that climate stress tests are now integral to risk management, and for the remainder this is in progress.** This suggests a major strengthening of integration of climate risk within risk management functions. Insurers appear to be more advanced on climate risk management compared to other participants.

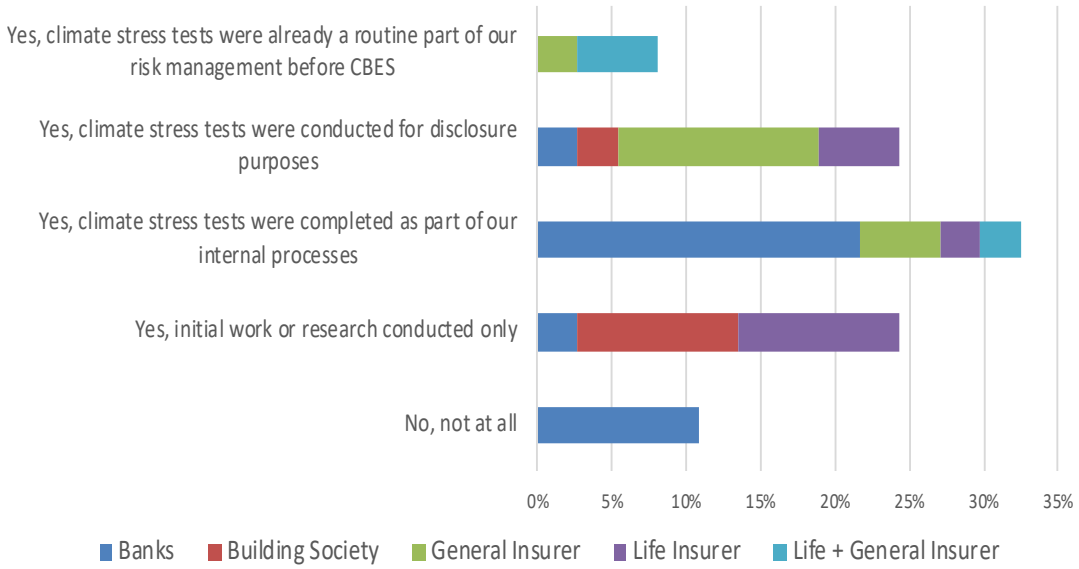


Figure 3: Had your organisation conducted some form of climate stress test before CBES?

CBES also appears to have increased the integration of climate stress tests within disclosures (24% pre-CBES, more than 40% post-CBES). However, only around 20% of respondents report that climate is now an integral part of business strategy, although the majority now say that this is in progress. This does raise the question as to whether the real economy impact of CBES is at this point is limited.

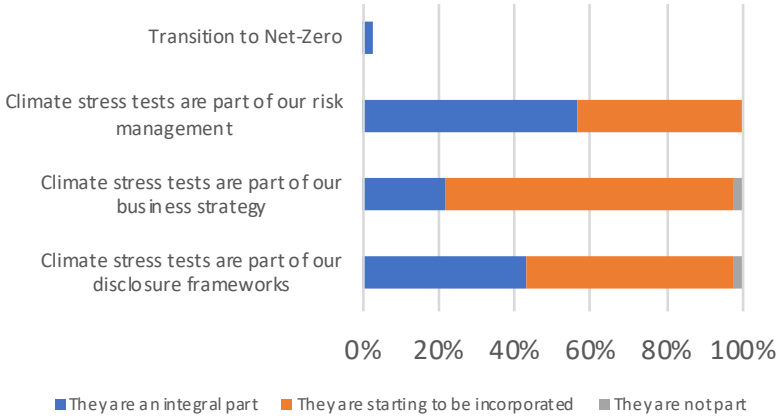


Figure 4: Role of climate stress testing within your organisation post-CBES

That said, well over 60% of respondents, strongly agreed that CBES had led to enhancements in technical capabilities on climate stress testing.

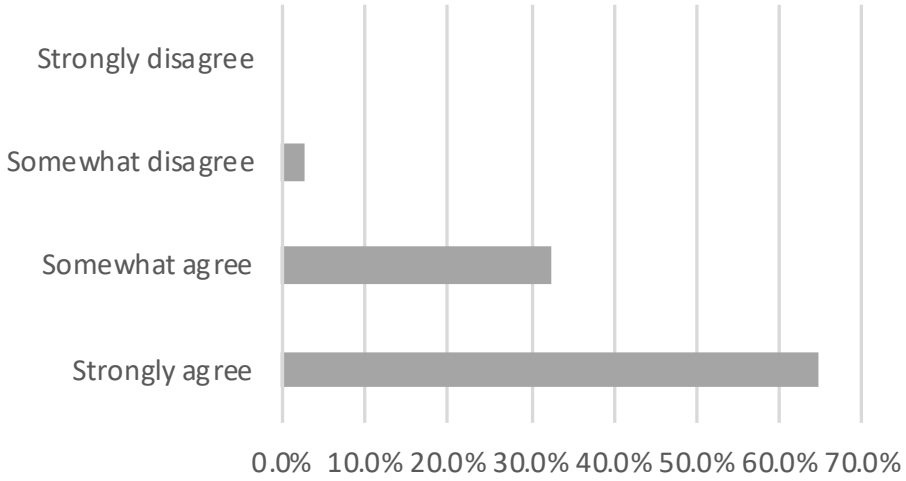


Figure 5: Responses to statement: 'the CBES process led to enhancements in our technical capabilities on climate stress testing'

In looking at what climate stress testing had been completed before CBES. 8% of respondents identified that climate stress tests had been carried out as part of risk management in relation to Taskforce for Climate Related Financial Disclosures (TCFD) and Own Risk and Solvency Assessments (ORSA) reporting, or as part of annual assessments of climate risks to the business. While **32% said that this was done as part of an internal process/stress test in relation to the Global Insurance Stress Test 2019 (GIST2019) and ORSA2020.** 24% said that this was part of their disclosure under TCFD and GIST, and **24% reporting that they had undertaken CBES 'Dry-run' analyses, third-party research, and GIST 2019.**

It is worth noting that there needs to be a degree if caution on interpretation here as different respondents appear to use different categories for the same thing e.g., GIST2019.

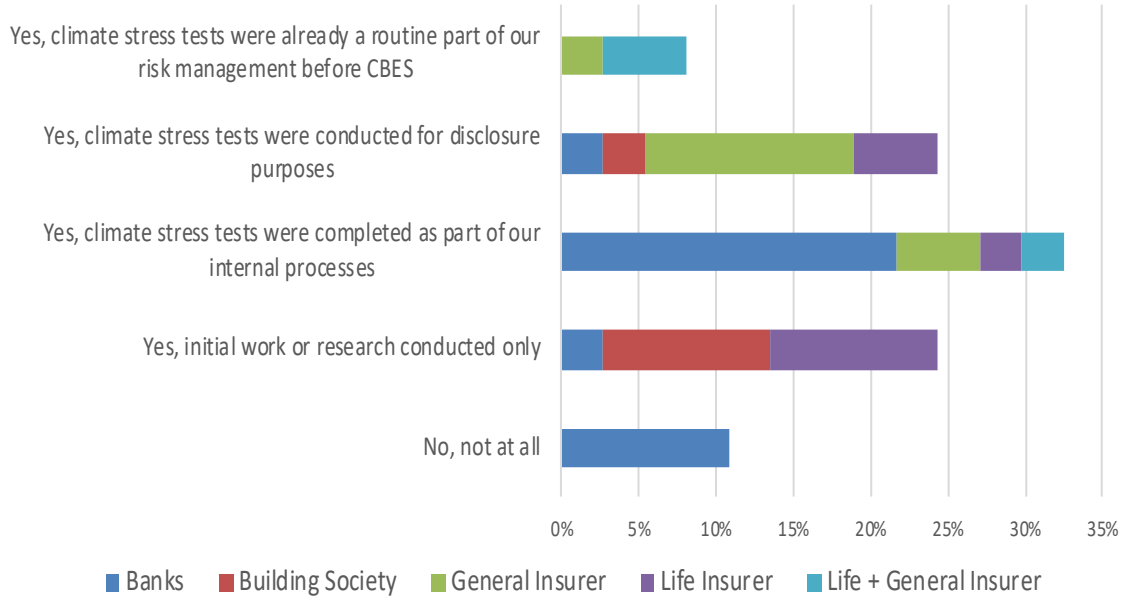


Figure 6: Responses to question 'Had your organisation conducted some form of climate stress testing before CBES?'

Insurers report stronger integration within risk management and disclosures, which, given the above descriptions, could be partly linked to the GIST2019 and ORSAs. **78% of respondents had analysed transition-related climate financial risks prior to CBES, 86% had analysed physical climate related risks, and 8% litigation risks.** The slight bias towards physical risks likely reflects earlier actions by insurers, potentially linked to GIST2019. In looking at to what extent CBES differed from climate stress testing and scenario analysis that had been conducted previously, there was a large split with 33% of respondents saying that the exercise was substantially the same and 67% saying that the exercise was substantially different.

For the respondents that said the CBES exercise was substantially the same, the reasons for this included:

- Had used NGFS or NGFS-compatible scenarios in internal stress test prior to CBES and assessed both physical and transition risks
- Previous exercises and dry-runs in the period leading up to the CBES were purposely designed to be compatible with upcoming CBES
- Already using static-balance sheet and macro-driven transition approach
- Had already completed aspects, e.g., flood risk at property level, for internal processes
- Existing internal models could be used, but substantially recalibrated to CBES

While for those that said the exercise was substantially different, the reasons included:

- Previous approaches had been much higher level. Significant model development and granularity was involved.
- Granularity required for the 100 counterparties analysis
- CBES scenarios were highly specified and required additional data
- CBES had different construct to previous exercises
- Internal exercises did not hold balance sheet constant

- GIST2019 was exploratory in nature. CBES quantitative templates
- Impacts on assets and liabilities (GIST 2019 just changes in assets)
- CBES questionnaire
- CBES required participants to determine GI risk variables and counterparty level impacts (whereas GIST2019 supplied the impacts on asset classes and GI risk variables)
- CBES required consideration of much wider asset base
- Greater number of physical risks included (coastal erosion, subsidence and tropical cyclone)
- Additional elements such as litigation risk
- Longer time horizon
- Client-level data and assessment required

With regards to the difficulty of implementing the CBES exercise, **67% of respondents ranked the difficulty in the top 3 categories out of 10.** There were a range of reasons given and these can be broken down into 4 key areas: Timeframe and resources; governance and management; data and models; and unclear instructions.

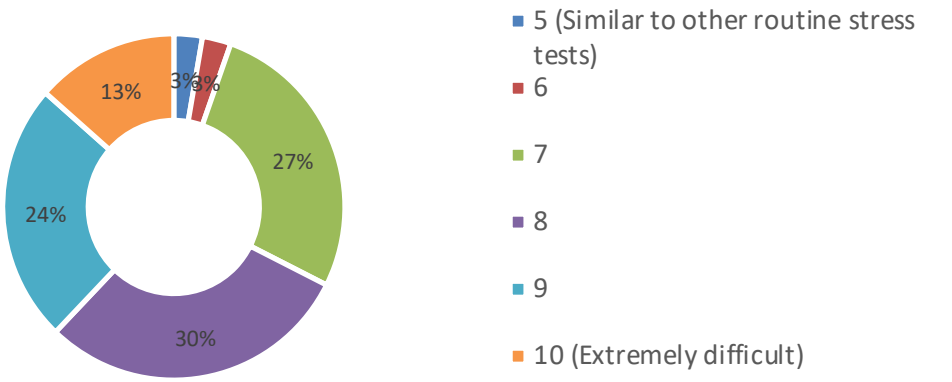


Figure 7: Responses to question: 'on a scale of 0 to 10, how would you rate the difficult of completing the CBES exercise?'

Looking specifically at **timeframe and resources**, there were several additional factors cited including, high resource requirements (human, data, models), the tight timescale, and difficult timing, e.g., with Solvency II at same time (and pandemic).

For **governance and management**, CBES required significant engagement with senior management and boards to present findings and agree follow-up actions, and internal governance and management across a large number of teams.

By far the most expansive category was around **data and models** with one respondent saying the instructions were unclear but with no further elaboration. In looking at the range of responses below with regards to data and models, there are clearly aspects of this that flow into the Data, Assumptions, and Scenario design analyses later, but there are also a range of

responses that indicate that this type of analysis was both new and challenging for the respondents but that there was also a concerted effort to do this well.

- Adjustments to internal models to ensure appropriateness
- Substantial external data had to be sourced
- Lack of industry benchmarks to validate (had to be built)
- Required new tools, models, and techniques to be implemented.
- Required first generation model development on tight timescale (e.g., entirely new data, perils and risk types considered)
- Complexity of modelling over 30-year time-period
- Unintuitive scenarios, e.g., static balance sheet (difficult to benchmark)
- Parts of analysis extremely taxing (e.g., counterparty transition plans reviews, granular property-level modelling, ETC ratings, physical risk distributions)
- Lack of available data in industry (need to resolve data quality issues)
- Infancy of climate modelling and ability of fully quantify risks
- Segmentation requirements very different to standard credit stress testing
- Extensive client outreach needed (e.g., litigation risk, transition plans, data)
- Very granular quantitative templates
- Onerous qualitative template – significant amount of work
- Material dependence on external data sources and models
- Training sessions for credit analysts and credit officers
- Required entirely new way of thinking
- Need to identify and collect data across multiple platforms and data providers
- New relationships with third party suppliers required

This is further evidenced in the figure below. Looking at the top 3 / top 5 challenges identified, the modelling of physical climate financial risks was the hardest aspect followed by building the internal technical expertise the exercise required. While both developing relationships with 3rd party suppliers and getting data from clients were very similar as top 5 risks (circa 60% on both), but with client data being much more prominent as a top 3 challenge.

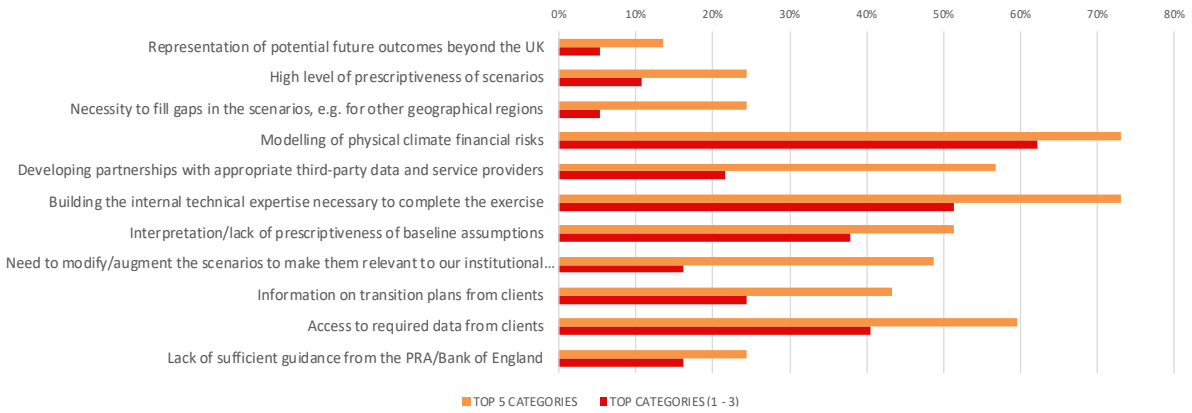


Figure 8: What are the key challenges for your organization in completing the exercise?

The impact of CBES implementation on organisational capacity

The majority of respondents agreed that CBES had led to enhancements in technical capabilities on climate stress testing that would be maintained over the medium to long term. Specifically, **over 90% of respondents say that the CBES exercise has increased the technical ability within the firm to undertake a climate stress test**, and over 60% strongly agreeing with this. As well as this, this increase in capacity is not seen as transitory, rather it is a wholesale upskilling that is envisaged to remain in the organisation with **over 90% agreeing that this increases in technical capability is expected to be maintained into the medium and long-term**, and just under 60% over respondents strongly agreeing with this.

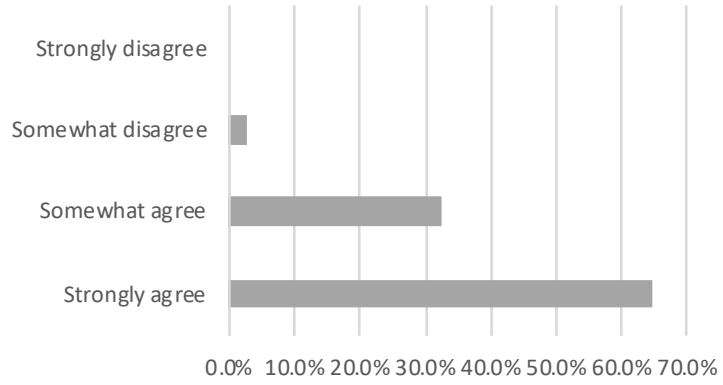


Figure 9: Responses to the statement 'the CBES process led to enhancements in our technical capabilities on climate stress testing'

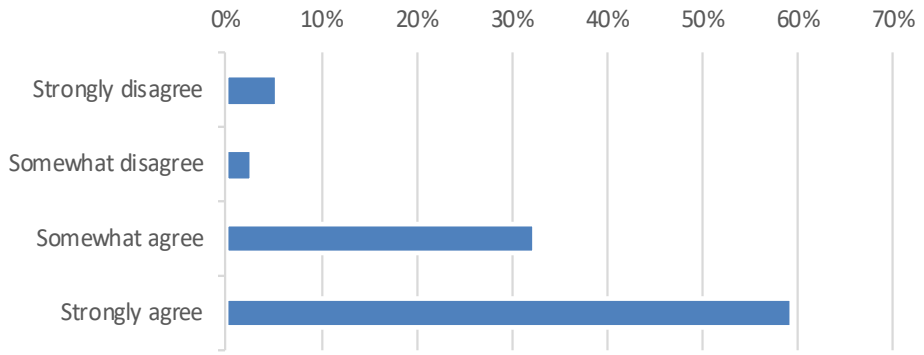


Figure 10: Responses to the statement 'the CBES process led to enhancements in our technical capabilities on climate stress testing that will be mainstreamed and built over the medium to long-term

Across respondents, **there is broad agreement on the positive impact of the exercise for awareness and ability to manage climate-related risks and opportunities within individual firms**, though around **20% disagree that the results themselves were directly useful**.

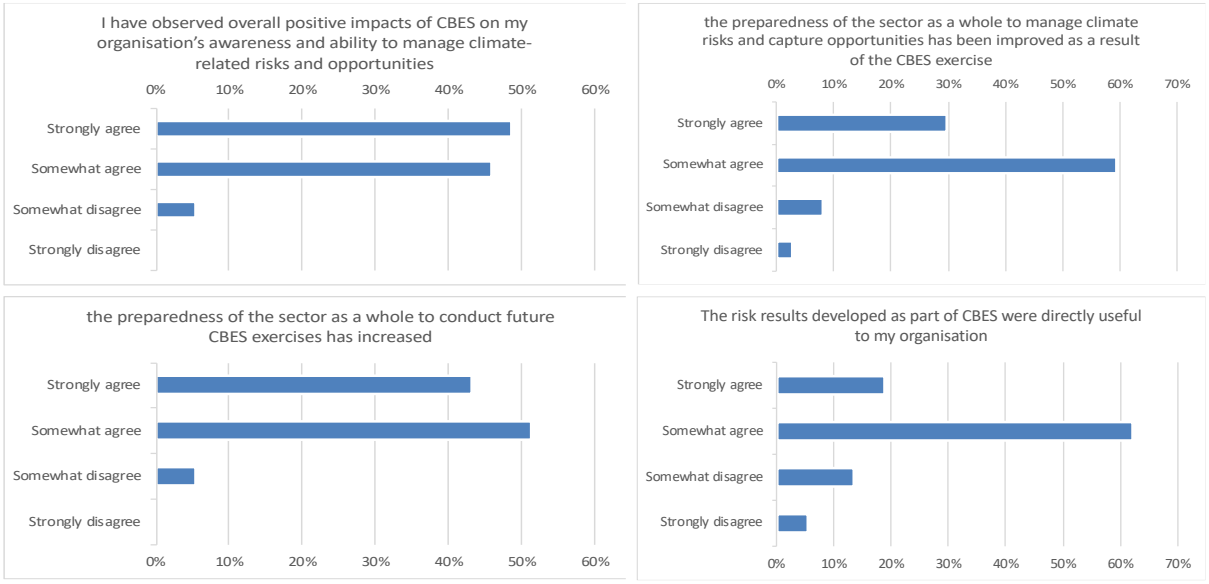


Figure 11: Impacts of CBES on the preparedness of the sector

It is also worth noting that there is also **broad agreement that CBES has increased the capacity of the sector as a whole to manage climate risks and capture climate opportunities** with just under 30% of respondents strongly agreeing with this and just under 60% somewhat agreeing.

As well as this around **95% or respondents somewhat agree or strongly agree the preparedness of the sector as a whole has increased for undertaking future CBES exercises.**

Just under 20% reported some negative impacts due to resource requirements, short deadlines, late delivery of instructions from the Bank of England, and difficulty given it happened during a challenging period (e.g., QIS).

Finally, in looking at **the direct positive impacts of CBES** with the participating organisations, are:

- A clear finding of high positive impacts of CBES in terms of awareness and engagement at Board and C-Level
- Training of staff
- Enhanced capability throughout the organisation
- Greater integration of climate risks into institutional risk management, credit risk analysis, and strategy.

While **consistently lower impacts are reported at the client-facing level are reported**, e.g., in terms of enhanced capacity of clients and data provision from clients. There was also, **less evidence in changes to investment strategies for specific business lines**.

It is also worth highlighting that some respondents note that some of the lower responses reported is because processes were already in place before CBES and/or were driven by other commitments, e.g. TCFD, FCA, TPR, or they are not aware of the impact.

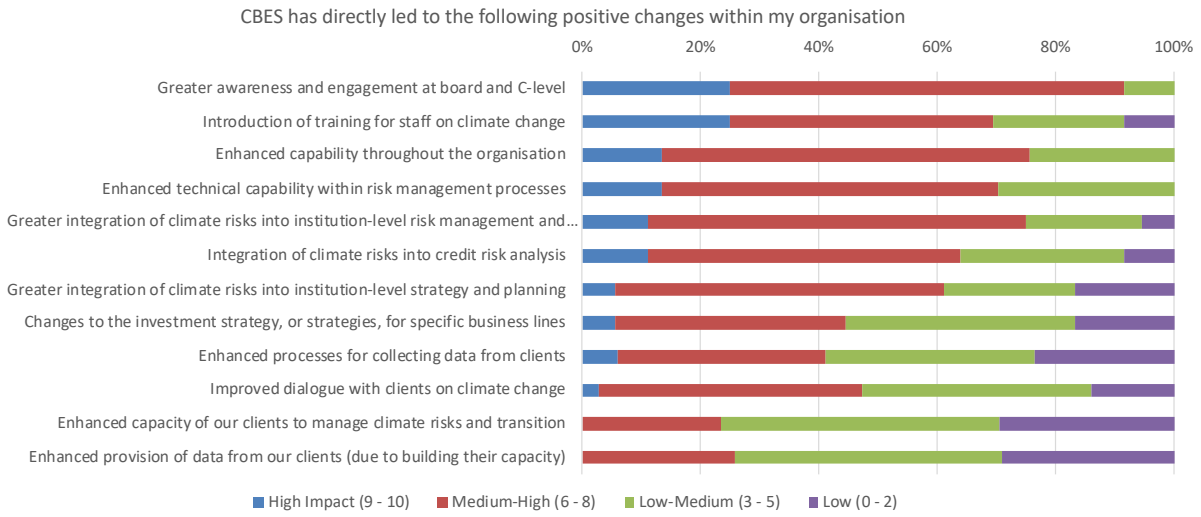


Figure 12: Responses to the statement: 'CBES has directly led to the following positive changes within my organisation'.

Finding 2: Data, assumptions and scenario design

Structure and assumptions

The design of the exercise was seen as broadly adequate given objectives of CBES, and appropriate to the capacity of the market and availability of data at the time the exercise was designed. As described in the Background section, choices over the design of the exercise necessitated trade-offs, such as the static balance sheet assumption and the scope of the risks included. Respondents gave feedback on whether they believed those design choices meant that the design was suitable for the objectives. Agreement on the suitability of the design of the exercise was strongest for the CBES objective to enhance the management of climate-financial risks; almost 60% of respondents strongly agreed with this. For sizing financial exposures and understanding challenges to business models (the two other of the three CBES objectives) around 20 – 35% strongly agreed with the suitability of the design of the exercise and around 12 - 16% of respondents disagreed. This is consistent with other findings of the survey on challenges identified due to some design decisions and trade-offs; in particular the static balance sheet may have led to overestimates of some risks, while missing risk transmission channels and drivers led to underestimates elsewhere.

One respondent specifically noted that given this was a first attempt, it is inevitable that it would not give a perfect answer in terms of sizing the risks, and many respondents noted the strong benefits of the exercise overall in terms of risk management capability and as a catalyst for further action internally. The lack of successful impact in terms of engaging counterparties to understand their vulnerabilities to climate change was noted by one respondent and this also came across in multiple of the interviews.

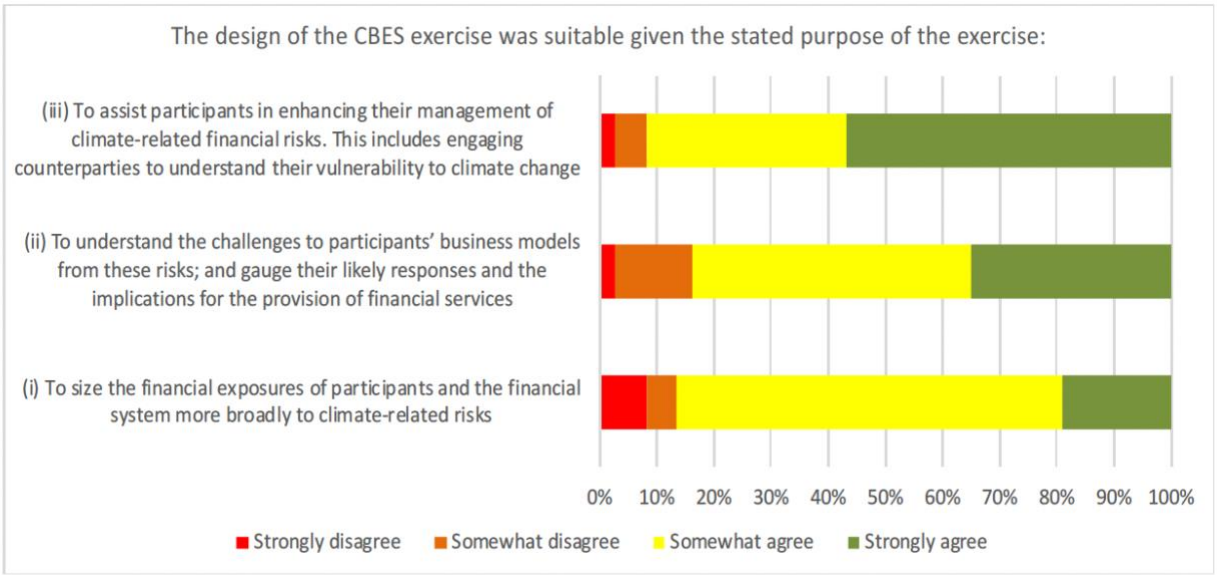


Figure 13: Responses to the statement 'the design of the CBES exercise was suitable given the stated purpose of the exercise'

Almost universally, respondents highlighted the **static balance sheet assumption** as a concern that limited (or even negated) the usefulness of the results and a priority to be addressed in future. As noted in the background section, this was a deliberate design choice by the Bank of England that was deemed necessary to ensure the credibility and consistency of the exercise. This limited the ability of the exercise to size the financial exposures; potentially leading to some risks being overestimated. For example, the assumption led to a build-up of expect credit losses (ECL) and an unclear view on how loss rates would actually evolve over time. *Workshop discussion also noted that the static balance sheet assumption was necessary at the time given the complexity of the exercise and the need to ensure comparability in results across FIs. But, it did affect the risk estimates and many respondents regarded the absolute numbers as not reliable as a result.*

Assumptions relating to the **baseline (or counterfactual) assumptions** were also highlighted as an area that should be changed in future exercises. It was noted that constraining assumptions made it difficult to link CBES results to client business models; and the **design of the exercise meant that many clients were assumed not to transition at all, which is unrealistic and would have increased to the scale of the transition risks being potentially unrealistic.**

Some specific aspects of the exercise were noted by some respondents as adding little value in terms of the objectives of the exercise, in particular the counterparty level analysis, which was regarded by some as little value add given the lack of data (particularly transition plans) and – from the interviews - the high uncertainties in sectoral level impact estimates. This part of the exercise was deemed necessary by the Bank of England both to provide insights into how advanced the firms were in their climate risk management processes and to explore what proxies and judgements would be used by financial institutions where gaps existed.

> *"The combination of quantitative modelling and qualitative expert review has given us comfort that the results are reasonable and consistent with the nature of the prescribed scenarios, subject to limitations from nascent methodologies, dependence on first generation external models and data challenges, most of which are shared across the industry. Whilst significant progress has been made in terms of our climate risk quantification capabilities, credible external benchmarks are still being developed and our recommendation is therefore to treat the quantitative results as a first step in a long journey towards improving climate risk quantification capabilities"*

Design of the scenarios

A key issue explored in the survey was whether the CBES scenarios were designed sufficiently to enable the participating FIs to capture all the expected material financial risks from climate change and relatedly, quantify the plausible range of potential impacts. These series of questions have implications for the suitability of scenarios given the stated objectives of the exercise. As noted above, deliberate design choices needed to be made by the Bank of England to ensure the credibility and practicability of the exercise – including the static balance sheet assumption and choice of risks to be covered - but here we explore the views of participants on the lessons learned to help inform future exercises and needs for research and methodological developments.

For transition risk, around 65% of respondents agreed that the range of scenarios was about right given current knowledge of the evidence by the market, while 24% felt that they were too narrow, so underestimating the plausible risks and 11% felt they were too wide (overestimating plausible risks).

The key issues noted by respondents that explain the perception that scenarios were too narrow (Table 2) can be grouped into those relating to: (i) the basic structure of scenarios – including the static balance sheet and counterfactual assumptions noted above; (ii) the range of processes captured; (iii) the structure of the exercise as a whole; (iv) specific (sectoral) assumptions. Missing processes highlighted included the potential volatility of transitioning and the likelihood and risks associated with a very delayed transition, and litigation risks related to the transition. It was also noted that the transition risk scenarios may not fully capture the benefits of the transition. Notably, some respondents noted that while there were deficiencies in the scenarios, it would have been difficult based on current evidence and capabilities to do more or better.

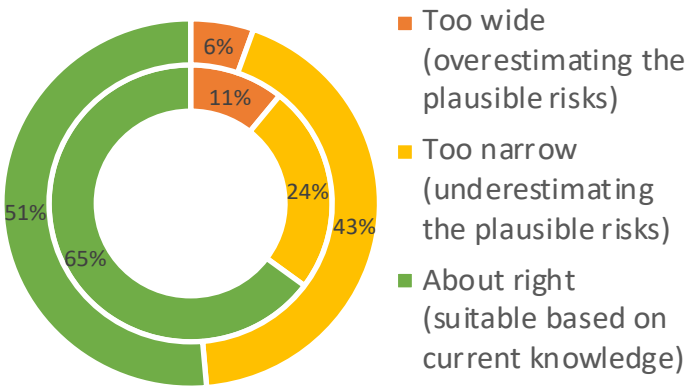


Figure 14: Responses to the statement "the CBES data and scenarios provided by the Bank of England/PRA adequately represented the plausible range of all material climate-related financial risks that could impact the UK financial sector over the next 30 years for transition (inside circle) and physical risks (outside circle).

The results were different for the case of physical risks, where only 51% of respondents agreed that the range of scenarios was about right given current knowledge of the evidence by the market and 43% felt they were too narrow, so underestimated the potential risks. This was complemented by the interviews in which many respondents noted that the physical risk scenarios were not stress scenarios and the results appeared unrealistically low. Most respondents noted a rationale for this conclusion being the missing processes in the scenarios, including tipping points, feedback loops, supply chain disruption, indirect impacts, geopolitical risks, migration and conflict.

Transition Risk	Physical Risk
Structure of the exercise: • Counterfactual adjustments produced counterintuitive outcomes (persistent HPI deterioration before factoring in climate risks biased results) • Static balance sheet did not represent actions bank would expect to take **Structure of scenarios:** • Scenarios over-specified – too many variables constraining each other • Scenarios could be better aligned with expected government policy **Processes captured by scenarios:** • Disorderly scenario both under-represents the potential volatility of transitioning alongside over-representing the possibility of a successful transition if we delay actions for another decade. This future volatility and interaction with emerging changes in extreme weather that will present the most material risks to financial firms • Scenarios excluded key factors that could increase impact, e.g. litigation under fiduciary duty • Multiple scenarios to give plausible range of risks needed, e.g. different tech and policy pathways • Benefits of transition were not recognised **Specific assumptions** • EPC related transition risks appeared optimistic, given EPC by 2035 assumption • Distinguish between owner-occupied and buy-to-let mortgages (BTL has significant upcoming Minimum Energy Standards (min EPC C) due to be introduced in 2025 and 2028 • Technology risk, e.g. RV risk on hybrids and Evs	**Structure of the exercise:** • The UK was assessed to have a relatively low impact from physical risks, which could have been stressed more significantly to better represent an RCP 8.5 pathway. • The scenarios do not capture the risks of very severe climate events happening. This may be a more useful test for banks rather than incrementally worsening climate conditions • The static balance sheet assumption made no sense as all unsecured credit defaulted and dwarfed losses from climate **Processes captured by scenarios** • GDP drops from counterfactual not proportionate to the stress • BoE: "Furthermore the [NAA] scenario does not factor in other potential geopolitical impacts of severe climate change such as increases in migration and conflict, which alongside their enormous human costs, are likely also to result in further financial losses." • Feedback loops, tipping points, more extreme heat, supply chain disruption and indirect impacts not considered • Full extent of risks not understood – more collaboration across the industry needed to fully understand this area • Systemic financial impacts missing, e.g. recently seen material impacts on the financial system from supply chain disruptions • Multiple scenarios need to be investigated to give plausible range of risks, including more hothouse scenarios - e.g. 3 degrees plus • Reflect in the scenario that climate impacts are not equal - there will be winners and losers based on geography, industry etc. a simple example - if an area becomes more prone to flooding, areas that are relatively lower flood risk are likely to have enhanced valuations and associated economic damages

Table 2: Key issues raised by respondents to explain responses captured in Fig 14.

The following question particularly focussed on the issue of potential missing processes in the scenarios. Around 55% of respondents somewhat (or strongly) agreed that there are potential sources of climate financial risks or risk transmission channels not fully represented that could represent a material financial risk in the next 10 years; and this increased to 69% for timeframes covering the next 10 – 30 years. In the near-term, the types of missing risks or risk transmission channels identified included: greenwashing; liability risks; potential for rapid changes in market sentiments, such as shift away from oil and gas; underestimated physical risks; and additional regulatory requirements.

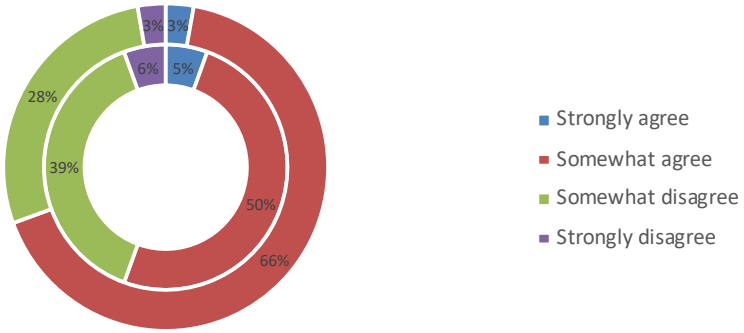
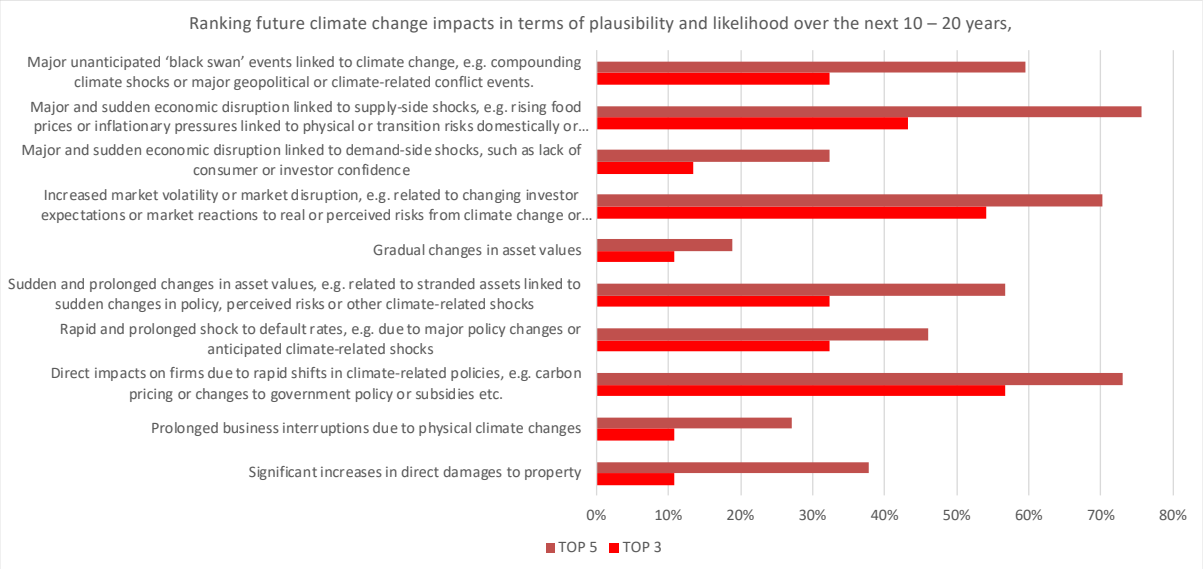


Figure 15: Responses to the statement "in my view there were some potential sources of climate financial risks to the UK or risk transmission channels that were not fully represented in the scenarios but could represent a material risk". Inside circle: near-term (up to 10 years); outside circle (10-30 years)

The medium-term risks identified were broadly similar with a greater emphasis on more non-linear and cascading risks, for example: indirect physical risks and increased volatility created by physical risks; life insurance risks (increased mortality and morbidity); lack of representation of severe GDP shocks; second-order macroeconomic impacts; operational risks; liability risks. One respondent noted that given the large range of uncertainty in current knowledge and limited evidence, while the current scenarios had limitations, this is probably the best that could have been achieved.

To help prioritise future investments in scenario development, we asked CBES participants to comment, based upon their broader knowledge and beyond the CBES exercise, on what are the top five types of possible future climate impacts that FIs should be most concerned about in the next 10 – 20 years? And how these would be ranked in terms of plausibility and likelihood (Figure 16).



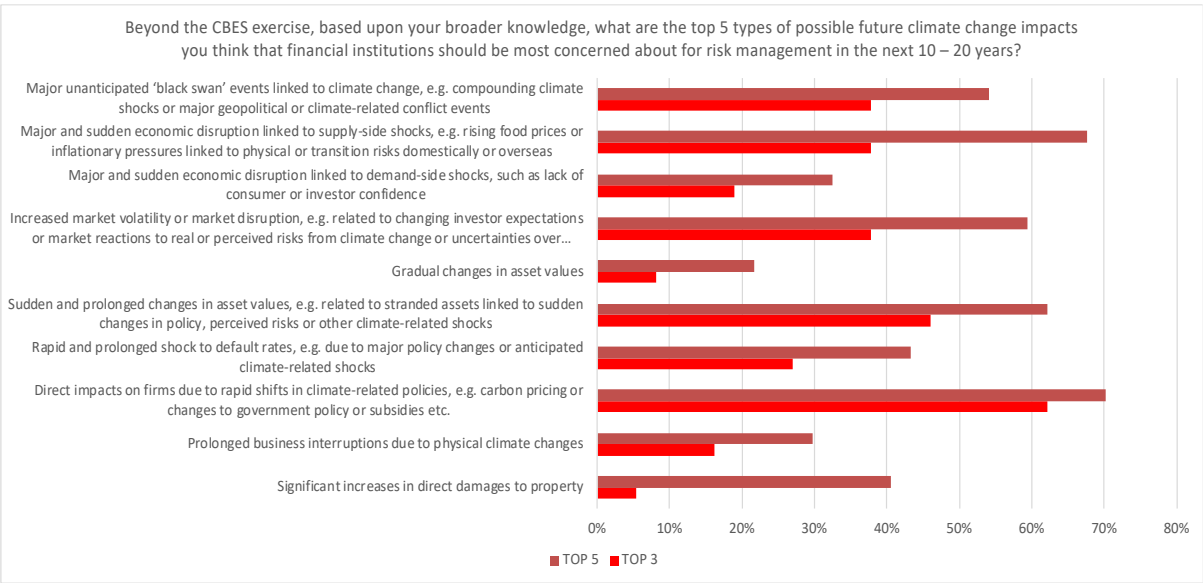


Figure 16

At least 40% of respondents agreed on three areas that were both considered most high impact and most likely/plausible in the next 10 – 20 years:

- **The potential for major and sudden economic disruption linked to supply-side shocks**, e.g. rising food prices or inflationary pressures linked to physical or transition risks domestically or internationally.
- **Increased market volatility or market disruption**, e.g. related to changing investor expectations or market reactions to real or perceived risks from climate change
- **Direct impacts on firms due to rapid shifts in climate-related policies**, e.g. carbon pricing or changes to government policy or subsidies

Also ranked highly (seen as slightly less likely in the next 10 – 20 years) were:

- **Risks of major unanticipated 'black swan' events**, e.g. compounding climate shocks or major geopolitical or climate-related conflict events
- **Sudden and prolonged changes in asset-values**, e.g. stranded assets linked to sudden changes in policy, perceived risks or other shocks

The survey then explored, for those areas ranked most highly above, did the respondents believe that the CBES approach to scenario design allowed those risks to be assessed and why (Figure 17). Many respondents expressed sentiments that the CBES scenarios provided a good first step given the need to build capability in the sector, the very challenging nature of the exercise and the limitations in data and modelling, though 37% believed that those top risks (previous) were not captured in the exercise and 27% believed they were only partially captured. It was noted that some of these risks would be extremely challenging for institutions to model. However, 37% believed the scenarios did broadly capture the risks that institutions should be considering, for example through the disorderly transition scenario. The static (fixed) balance sheet assumption was noted by several respondents as driving results that were too conservative. For example, this assumption meant that the situation where finance would be withdrawn from sectors before alternatives became available was not captured and this could create major economic risks.

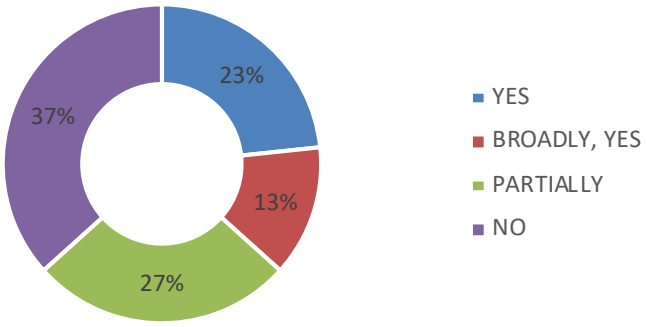


Figure 17: Responses to the statement "for those areas you ranked most highly [above], do you believe the approach taken by CBES adequately allowed those risks to be assessed"

It was also noted that the broad macroeconomic impacts of climate change e.g. in the late policy scenario were relatively modest and less severe than many business-as-usual stress tests. The lack of representation of potential 'black swan' events was noted by several respondents, including compounding of more extreme scenarios with non-climate risks, e.g. geopolitical. It was noted by several respondents that CBES scenarios did not explore volatility or ranges of plausible outcomes.

On the transition risk side, it was noted that government policy changes have great potential for surprises and this is not fully captured. The transition was seen as too smooth versus the likely reality by some. On the physical risk side, again the emergence of physical risks was seen as too gradual by some; 'averaging out' and so underplaying the potential for shocks and catastrophe events. Direct damages to property were noted to be understated by some and indirect physical risks, such as supply chain impacts, were missing. Some noted limitations in the ability to represent market behaviour (e.g. due to frequency of scenario variables – annual vs weekly) particularly related to rapidly changing conditions or shocks.

Data: challenges and solutions

The Bank of England provided a large amount of data to participating firms to assist them in the exercise and ensure consistency in responses. In the case of physical risk, three-quarters of firms reported augmenting this data with in-house or third-party data and models to complete the exercise, and just over half of firms for transition risk.

The data gaps that were filled, included:

- For transition risk:
    - Additional risk variables and downscaling for sensitive sectors, e.g. cement, auto
    - Counterparty specific information
    - Adjusting macroeconomic variable (MEV) data for counterfactuals and EPC data
    - Estimating EPC (Energy Performance Certificate) data to fill missing data
    - Extending scenarios to include different macroeconomic impacts, more Tier 1 analysis and consideration of abatement
    - Extensions to illiquid asset classes (e.g. equity release)
    - Adaption of energy prices
    - Narrative on behaviour of economic/industrial sectors under scenarios
    - Regional splits of CBES variables
    - Risk of credit default
- For physical risk:
    - Third-party hazard-specific risk data and modelling: subsidence, flood, coastal, specifically for Tier 1 assets (or third-party assistance in calibrating).
    - Adjusting macroeconomic variable (MEV) data to include counterfactuals
    - Property-level location information and characteristics (Tier 1), including adaptation assumptions

For physical risk, issues with the inflexibility of current physical risk models, both in-house catastrophe risk models and third-party models, to be calibrated to the CBES scenarios was noted as a constraint. It was mentioned that using IPCC-based scenarios (RCPs) could have avoided this as most existing models are calibrated to these.

Only one respondent reported that they had not engaged any third-party suppliers to support with the CBES exercise. The vast majority did engage a third-party and for 70% this was for support on data and modelling. Other roles included data collection with counterparties, high level guidance and review and for physical risk assessment specifically. Where information on third-party firms was provided, it was notable that the same small number of companies appear to have supported several CBES participants. These included consultancies (general and specialist), physical risk modelling and ESG data companies.

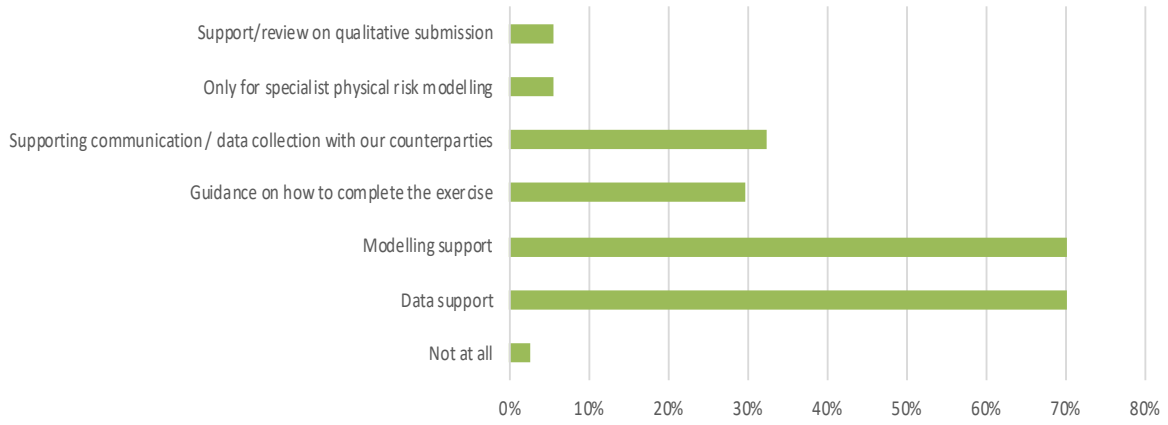


Figure 18: Did third party data and service providers play a role in supporting your organisation and how?

Finding 3: The CBES process

> *"Very good exercise, well run by the Bank, including excellent engagement throughout"*

Several respondents noted the very good engagement of the Bank of England team with the CBES participants.

Some respondents noted the intensity of the exercise and the high resource requirements, which placed further strain on the firm and its ability to deliver, particularly as CBES happened concurrently with other regulatory processes and during COVID-19. There was a call from some respondents for a period without another request from the Bank of England, to allow firms time to develop their methodologies and tools and properly understand the impacts. Other respondents felt that there needs to be regular climate scenario supervisory exercises to ensure firms have the right focus and build their capability over time *(see workshop report where respondents noted that the mainstreaming of climate within routine supervision obfuscates the need for dedicated exercises, and that if such exercises are undertaken this should be with clear objectives different to CBES).* Some respondents commented that at the moment there is a lack of direction from the regulator, hence firms feel hesitant to build out their capability. Other respondents suggested smaller but more targeted exercises that will support the further embedding of climate scenario analysis within FIs and the Central Bank itself, and look at specific risks, such as credit downgrades/defaults.

Other comments made by the CBES participants for future exercises included:

- Question regarding the utility of the detailed balance sheet templates that firms needed to fill out as a means of submission
- Requests for more guidance
- Requests for objective steer from regulators on modelling techniques, including how the variabilities provided should be applied and modelled.

- Requests for more variety in scenarios provided and sufficient information to enable firms to adapt their approaches to best suit their risk profiles.
- Requests for simplification of variables and clearer explanations of scenario drivers.

Finding 4: Design of future exercises

> *"CBES was extremely challenging to complete, but invaluable and has set us on the right path to improve our understanding and assessment of the associated risks"*

Broad characteristics

The penultimate section of the survey asked a series of questions to elicit views and learning concerning the design of future scenario analysis and stress-testing exercises by Central Banks and supervisors. Generally, respondents agree that for future climate stress testing exercises in the UK, it is important that financial regulators provide scenarios that are consistent, well specified and aligned to those of other regulators (e.g. the ECB), versus more detailed and tailored scenarios or those that require financial institutions to develop their own assumptions. However, there is a divergence of views amongst financial institutions and generally a view that there needs to be a balance between the two, with the right approach depending on the goal.

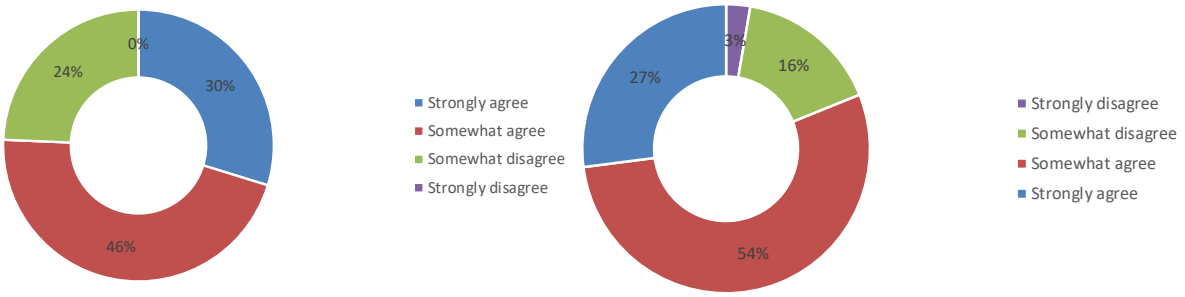


Figure 19: For future climate stress testing exercises in the UK, it is most important that financial regulators provides: (left) scenarios that are consistent and aligned with those of other regulators (ECB) rather than more detailed and tailored scenarios for the UK; and (right) more specificity in scenarios and assumptions to ensure consistency, rather than scenarios that require FIs to develop their own assumptions.

Arguments for consistency across sectors and countries include: most important for analysing system-wide risks and for building comparability and transparency; resource efficiency and building capability (providing significantly different scenarios consumes resource and time available to enhance the sophistication and embed climate model); avoids companies choosing whichever version of climate scenario exercise they prefer (race to the bottom?). It was also noted that consistency eases processes for companies harmonising across a large

(international) group and enables these companies to analyse global risks. However, it was noted that scenarios tailored for the UK are a better fit to analyse UK portfolios; risks pertinent in one country do not necessarily map onto other countries, and so adopting the same scenarios as another jurisdiction without local adjustments could be problematic and counterproductive.

It was also noted that to ensure comparability of results, further standardisation is required (e.g. of assumptions) beyond that prescribed by CBES. Some consensus emerged that while institutions should run their own internal exercises using scenarios that most fit to test their business model and risk profile, for industry wide regulator-run exercises comparability and therefore consistency is important. Stress tests should be relevant for the particular sector and country they are designed for, but should to a degree be able to be compared with results from other regulator's stress tests to give a holistic view.

Given novelty of this type of exercise, more prescriptiveness was seen by some as useful. Consistent inputs and so outputs also help FIs align their thinking in this new space and eases interpretation and understanding of the relevant positions of FIs against their peers. However, it was also noted that FIs need to develop their own views and judgements on the risks relevant to them, rather than focus their energies solely on running regulator scenarios.

Specific adjustments to design

The priority change requested by respondents in the CBES scenarios, data and assumptions relate to the **static balance sheet assumption** and the **counterfactual/ baseline scenario**. Well over 60% of respondents placed these in their top 5. Short-term scenarios, more standardization and more comprehensive guidance also came out strongly as priorities for future exercises. There was also a general call for more guidance to help complete the exercise. Areas that came out lowest were additional data provided by the PRA and lower prescriptiveness of assumptions. Other recommendations that emerged from the text responses to the question included: provision of global GVA pathways, allowing physical risks to linked to RCPs, simpler variables, clarity on macroeconomic assumptions, flood maps and more guidance on company transition plans. It was noted that scenarios should more closely represent real expected government policy, including for example on carbon price trajectories.

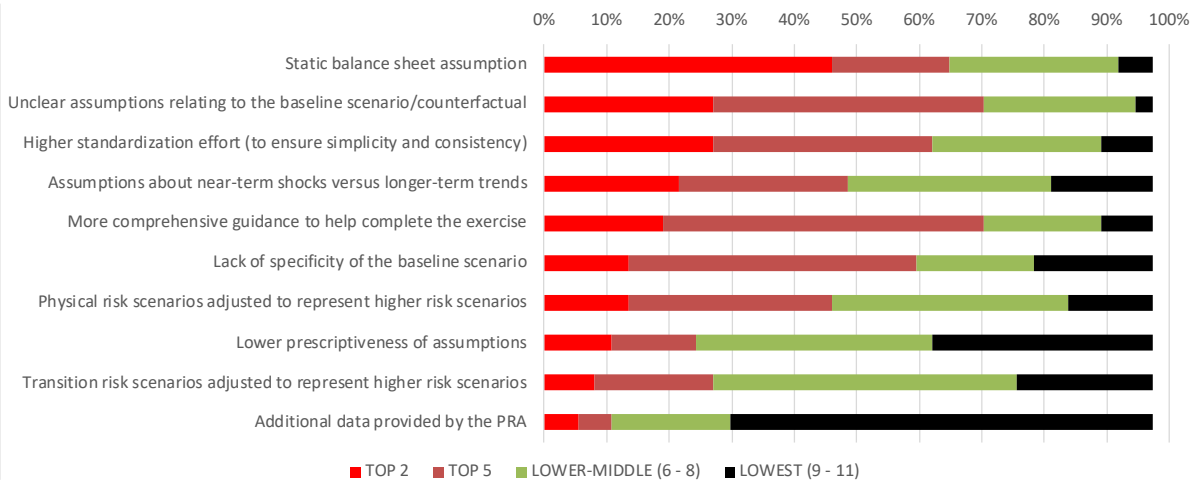


Figure 20: What would you change about the CBES scenarios, data and prescribed assumptions?

Static balance sheet assumption: this assumption was noted by most respondents as a key issue and a potential driver of overestimation of losses. For example, for general insurance, it was noted that the industry has the ability to respond dynamically to material risks, while another participant noted that this assumption meant all scenarios were treated as 'shocks' to the balance sheet that could not be prepared for in advance, hence unlikely; and that bad debt tended to accumulate in the modelling which is not realistic. The impact of this static balance sheet assumption (and the accumulation of debt that resulted) in the counterfactual scenario was noted by one participant as being larger than the impact of climate change itself.

> *"A very useful exercise in building capability but the results did not get the focus they could have done because of the static balance sheet assumption"*

It was noted that there were some counterintuitive assumptions; e.g. oil price trajectories and the benign GDP shock in the "No Additional Action" scenario. **Greater transparency on the assumptions driving the scenarios** was also called for, including on missing risks. The missing of second-order and indirect impacts of climate shocks were specifically noted, as were more severe physical risk scenarios and incorporating the current energy shocks. The importance of climate scenarios for **short-term time horizons**, equivalent to current financial planning cycles, was also noted as a priority.

Usefulness

> *"It was an interesting exercise but requires more fine tuning to ensure more benefit can be extracted from the exercise"*

Over one third of respondents strongly agreed that the CBES data and scenarios would need to be further investigated and modified to be suitable for the climate stress testing needs of their firm, and an additional 57% somewhat agreed. This is not unexpected given that (in the workshops) firms noted that scenarios from supervisory exercises would never normally be adopted for internal risk management without adjustment to firm specific circumstances and information. However, this does imply that the CBES data and scenarios are some distance from what firms would be comfortable to use for their own internal stress testing. Respondents raised a large number of issues and needs. Many issues related to specifically accounting for the FIs own portfolio structure, expectations on future scenarios, and in-house views on their sectors of interest (mortgages, EVs, life/mortality/morbidity), as well as including their own strategies and approaches to climate risk. Other more generic issues included: dynamic balance sheet and allowing transition by firms; representation of extreme scenarios; fine tuning scenarios; short-term scenarios; UK specific assumptions (e.g. BLT mortgage sector and changing policy environment). In general, it was noted that data needs would become more robust if they are to support the high bar required for internal stress testing, and that there is a need to accelerate the natural process of maturing of data.

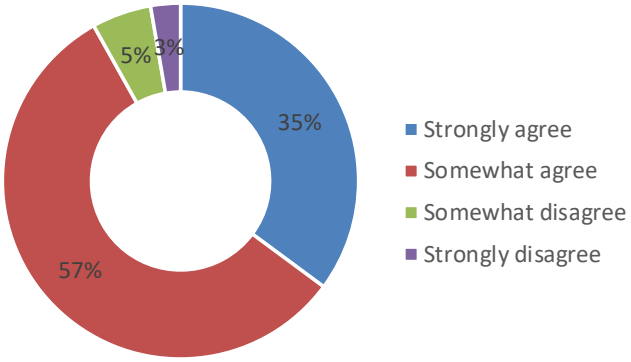


Figure 21: Responses to the statement "the CBES data and scenarios would need to be further investigated and modified to be suitable for the climate stress testing needs of my organisation"

Finding 5: Future data and research priorities

> *" The unforeseeable elements of climate change (naturally) are the most likely to be the most serious. Stress testing can only provide meaningful results for potential impacts that have already been considered. However, it could be unwise to rely on the results of stress tests to demonstrate that the financial sector has a good understanding of the potential impacts of climate change"*

The final part of the survey elicited perspectives on the priorities for researchers and data providers to support future scenario analysis and stress testing. The following priorities were identified by the respondents:

- **Counterparty data, transition plans and adaptation plans**
  - **Majority: Credible and consistent data and disclosure on counterparty exposure to climate change (inc. transition plans and adaptation plans**)
  - Collection of data required to assess litigation risk
- **Improved representation of physical climate-related financial risks:**
  - Details on expected changes in weather patterns in the UK
  - Modelling/understanding of how extreme events disrupt economies
  - Closing property-specific data gaps, including supply chain data
  - Improved observations of impacts on assets today
  - Full assessment of impacts of hot-house world, taking into account full range of transmission channels, feedback loops and tipping points
- **Techniques for modelling risks, transmission channels and stress testing**
  - Translating company disclosures into info that is granular enough to model financial impacts

- Representation of full scale of potential supply chain impacts
- Understanding and modelling transmission channels for risks to develop and impact a firm's balance sheet
- Methods to appropriately combine the data; models and scenarios; getting the right balance between analytics and more qualitative approaches to scenario analysis
- Greater understanding of the relationship and sensitivity of stress test results to different variables
- Translation of climate pathways into multi-year economic scenarios.
- Short-term scenarios, e.g. building upon those of the ECB stress test

- **Transition Scenarios**
  - Scenarios more closely aligned with expected and potential UK policy, representing potential ranges of outcomes and implications of timing of key variabilities, e.g. carbon price.
  - Representation of the lack of uncertainty in the global transition pathway
  - Emerging market vs. advanced economies variations in transition pathways

Conclusions

The central goal of this research was to capture and synthesise the learning from the CBES for UK FIs but also to share internationally. The improvements in capability and awareness of financial institutions as a result of CBES come through strongly from the analysis. It was clear that choices over the design of the exercise – understood by the Bank of England at the time – did impact on the results, particularly the sizing of financial risks. But also that those design choices were likely the best that could be made at the time given the status of capability of FIs, available knowledge and data, and also lessons from other supervisory exercises. The feedback from respondents provides a useful perspective of whether those design choices meant that the design was suitable for the stated objectives and how it should be interpreted, as well as, importantly, expert perspectives on the directions for future exercises and where efforts to develop scenarios and methodologies can be most beneficial.

A potential limitation of this research is that it only focussed on the CBES, whereas in the UK this was one (important one) of several regulatory and supervisory interventions that would contribute to improvements in capability and risk management, in particular SS3/19. For other Central Banks, this is important to consider, as the impact may have been different (less) if the exercise were conducted in isolation. This does speak to the important lesson that climate scenario analysis can be only one of a toolkit of interventions that should be adopted by Central Banks and supervisors.

Many of the findings of this research will have read-across to other Central Banks and Supervisors. The design and operational challenges encountered and described in this research were not unique to the UK and through sharing these openly we hope that we can assist other countries in advancing their own climate resilience objectives.

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