Network for Greening the Financial System Technical document

NGFS scenarios: Purpose, use cases and guidance on where institutional adaptations are required An explanatory note

January 2024



Executive Summary

Since their publication, the NGFS scenarios have assisted central banks, supervisors and other financial actors in exploring various potential future outcomes of climate change and the transition. The unique features of the NGFS scenarios include internally consistent results that combine transition and physical risks with macro-financial developments, applicability at the global level and free accessibility through an online public platform. The NGFS has strengthened its scenarios across successive vintages, refining its modelling techniques and extending the coverage of modelled risks. Consistent with other available scenarios, however, the NGFS scenarios do not account for every potential implication of climate change despite the significant progress made in incorporating the current state of climate knowledge, computational capabilities, and user needs. Scenario users should seek to tailor their analyses to suit their needs and to determine which additional risk assessment tools and scenario calibrations may be required. The main areas where users may need to adapt the intensity of the scenarios include tipping points, physical impacts that are not captured at present, societal impacts such as migration influenced by climate change, compound risks, the calibration of physical damages, technology assumptions, government policy changes and financial sector dynamics. Consistent with best practice, scenario users should provide a narrative or qualitative explanation of what their exercise is designed to achieve and how their scenario adaptation fulfils these objectives. Crucially, the NGFS scenarios provide clear evidence that early action delivering an orderly transition to achieve global net-zero emissions by 2050 is the optimal pathway for minimising climate-related risks and losses.

Introduction

Since their publication, the NGFS scenarios have assisted central banks, supervisors, and other financial actors in exploring various potential future outcomes of climate change and the transition. Introduced as a novel tool in 2020, the scenarios have been consistently refined and updated over four iterations. This note sets out the purposes and use cases for scenarios. It also reiterates that the scenarios provide a common basis and reference framework for analysis purposes while additionally serving as a reminder to users that they may need to further adapt the scenarios to suit their particular needs. The scenario toolkit is designed to facilitate these adaptations and evolve over time, in addition to providing an increasing number of options for users. The note concludes with a selection of frequently asked questions about the scenarios and will be updated over time to reflect latest developments.

1. How does scenario analysis help with assessing climate risk?

Climate change is one of the most important challenges currently facing societies and policymakers worldwide.

The science is clear about the adverse impacts and growing threats posed by climate change¹. The importance of tackling global warming is reflected in policy commitments adopted by the international community under the Paris Agreement. Mounting physical risks alongside transition policies for risk mitigation have direct implications for the macroeconomy and the financial system.

Climate-related risks are characterised by a combination of certainty that some risks will occur, yet also by radical uncertainty about their scale and scope, given the forward-looking, anticipatable, and largely irreversible nature of climate change. Along with the difficulty of estimating the magnitude of damages, this presents a particular challenge in terms of assessing and preparing for their future impacts². The link between

greenhouse gas (GHG) emissions, the rise in global mean temperatures, and the increase in frequency and severity of extreme weather events are well documented in the scientific literature³. However, exactly predicting specific disaster events – or the magnitudes of damages – remains an infeasible exercise under higher warming scenarios. The traditional risk approaches calibrated on backwardlooking data are insufficient to forecast future impacts of global temperature rises that we have not yet experienced. Future policy pathways and macroeconomic changes stemming from transition and adaptation measures remain highly uncertain. This calls for novel approaches that recognize the uncertainty by capturing a range of potential future outcomes. While undoubtedly a difficult task, climate scenarios, such as those offered by the NGFS, and climate risk modelling are powerful tools to navigate an uncertain future.

Recognising the urgent need for a forward-looking analytical toolkit to assist in navigating uncertainty and addressing risks from climate change, the Network for Greening the Financial System (NGFS) has led the way in developing climate scenarios for central banks, supervisors, and the financial sector, while consolidating best practices in climate scenario analysis. Acknowledging the inherent uncertainty of forward-looking modelling, the NGFS, in collaboration with a consortium of well-established academic teams, in 2019 started developing a foundational set of tools and datasets to provide a starting point for analytical work⁴. Since then, the NGFS has enhanced its scenarios in successive vintages, refining the modelling techniques and extending the coverage of modelled hazards. This includes the incorporation of acute physical risks on top of chronic climate impacts, with Phase IV adding droughts and heatwaves in addition to the flood and cyclone hazards that had been previously integrated. The scenarios should not be interpreted as forecasts, but as potential pathways given the assumptions outlined for

¹ www.ipcc.ch/report/ar6/syr/.

² The green swan – Central banking and financial stability in the age of climate change, www.bis.org/publ/othp31.pdf.

³ www.ipcc.ch/report/ar6/syr/.

⁴ As of 2023, the academic consortium included the Potsdam Institute for Climate Impact Research (PIK), International Institute for Applied Systems Analysis (IIASA), University of Maryland (UMD), Climate Analytics (CA), Swiss Federal Institute of Technology in Zurich (ETHZ), and National Institute of Economic and Social Research (NIESR).

each narrative. This approach allows users to evaluate potential impacts across a range of plausible pathways, reflecting both policy and climate factors. It should be reiterated that users should determine and be prepared to justify which tools best suit their needs and adapt the scenarios to their use cases accordingly⁵. Users should be aware that the NGFS is constantly working to further improve the scenarios, including with regard to physical risks or the consideration of polycrises. It cannot be excluded that the economic effects of climate change might turn out to be even more severe than visualised under the NGFS scenarios, for instance, if certain tipping points are reached. Thus, users should also take into account the tail risks of climate change, along with other risks such as nature-related ones, which are not necessarily captured by these scenarios⁶. While the NGFS climate scenarios are certainly a helpful tool, they do not alleviate the responsibility of banks and other (financial) organisations to design and implement their own risk management frameworks.

2. How do the NGFS scenarios fit in the global climate scenarios framework?

The NGFS scenarios were developed primarily for risk assessment purposes, their focus being the assessment of impacts on the economy and on the financial sector over long time horizons. They are intended to serve as complements to other scenarios such as those of the Intergovernmental Panel on Climate Change (IPCC) and International Energy Agency (IEA) and have become an increasingly important tool for central banks, supervisory and regulatory authorities, and financial institutions. Similarly to the IPCC and the IEA, the NGFS has developed transition pathways for a variety of narratives. Yet, the NGFS subsequently tailors

the scenarios to the financial sector's needs using a suite-of-models approach, which links physical risk and transition models to the macroeconomic model NiGEM⁷ for the purpose of simulating key macroeconomic and financial developments.

The unique features of the NGFS scenarios include internally consistent results that combine transition and physical risks with macro-financial developments, applicability at the global level, and free accessibility through an online public platform8. Transition risks are, in the first place, captured using Integrated Assessment Models (IAMs). Physical risks are captured by a damage function for chronic physical risk impacts and Natural Catastrophe Models for acute physical risk impacts. Four acute physical impacts have been included in the framework so far, each modelled using one transmission channel. Floods and cyclones are modelled through projected capital asset damages, droughts through projected crop yield losses, and heatwaves through labour productivity decline projections across numerous warming levels⁹. Internal consistency is ensured by aligning parameters across the various models. All risk elements are eventually brought together in the macroeconomic model NiGEM¹⁰.

The NGFS scenarios provide consistent and complementary results compared with the IPCC Illustrative Mitigation Pathways. Similarly to the IPCC, the NGFS uses IAMs to develop the transition pathways. Three of the seven NGFS scenarios can be regarded as more detailed versions of IPCC illustrative mitigation pathways¹¹. More generally, compared with other scenarios assessed by the Working Group III of the IPCC Sixth Assessment Report (AR6)¹², the NGFS scenarios have higher sectoral

- 5 For example, more than half of the financial authorities surveyed by the FSB and the NGFS in 2022 adapted their use of NGFS scenarios with further adjustments. See www.fsb.org/2022/11/climate-scenario-analysis-by-jurisdictions-initial-findings-and-lessons/.
- 6 Disclaimer: neither the NGFS, nor its member institutions, nor any person acting on their behalf is responsible or liable for reliance on, or the use that might be made of these scenarios. This also applies for the use of the data elaborated under the scenarios see section 5 in https://data.ene.jiasa.ac.at/ngfs/#/license.
- 7 National Institute Global Econometric Model (NiGEM). See <u>www.niesr.ac.uk/nigem-macroeconomic-model</u>.
- 8 <u>www.ngfs.net/en/ngfs-climate-scenarios-phase-iv-november-2023.</u>
- 9 More detailed description of the physical risk modelling framework and methodology can be found in the NGFS Scenarios Technical Documentation: www.ngfs.net/sites/default/files/media/2023/11/07/ngfs_scenarios_technical_documentation_phase_iv.pdf.
- 10 NiGEM's global coverage aligns with the scope of the NGFS, but its integration of climate risks and link with IAMs is a novel feature, which might not be capturing all transition risks and mechanisms. Geographical and sectoral granularity may be insufficient for some use cases. Users might opt for alternative macroeconomic models for supplementary analysis and scenario customization.
- 11 Net Zero 2050, Below 2 °C, Low Demand.
- 12 www.ipcc.ch/report/sixth-assessment-report-working-group-3/.

and regional granularity on average, which enhances their utility for financial risk analysis ¹³. The NGFS scenarios are well aligned with the IEA package across several dimensions yet have specific characteristics that are useful for a variety of applications. In particular, the IEA scenarios focus on the energy system for primarily developing an understanding of the implications of transition policies and technological changes, albeit excluding physical risks ¹⁴. By contrast, the NGFS scenarios incorporate the physical impacts of climate change and offer a more advanced toolkit for assessing transition impacts within the financial sector.

The NGFS scenarios, like all alternative climate scenarios, do not account for every potential implication of climate change despite the significant progress made in incorporating the current state of climate knowledge, computational capabilities and user needs. Without macro-financial climate scenarios, however, it would not be feasible to undertake scenario exercises that explore both transition developments and physical risks under different pathways and their impacts on macroeconomic and climate variables, by using a common reference framework. This has enabled the benefit of consistency and comparability of results across entities and jurisdictions on a global scale, while avoiding the high costs of every institution developing their own framework and models in isolation. The NGFS scenarios model most countries as components of broader regions rather than individual entities, while there are variations in data quality and availability among countries, which could lead to less representative model results¹⁵. The NGFS has continued to maintain transparency around the scenario limitations and to further clarify the assumptions in each iteration of its scenarios. IAMs and physical risk assessment frameworks that underpin scenario modelling are appropriate tools for providing long-term baseline projections but come with known limits 16. These include the inability to capture "known unknowns" such as the impacts of tipping point events and extreme tail risks, non-linearities arising from second-round effects and only a limited – albeit expanding – subset of acute climate impacts being modelled. Aware of these potentially missing impacts in the results, one should not consider the NGFS scenarios as a suitable standalone instrument for a cost-benefit analysis on the opportunity of climate action. Nor should they be used to determine an optimal level of global temperature increase regarding mitigation costs¹⁷. As things stand, the current set of scenarios should be seen as providing a robust but non-exhaustive estimate of potential damages from climate change. This note defines a number of areas in which users can incorporate additional adjustments.

The NGFS scenarios provide clear evidence that early action delivering an orderly transition to achieve global net-zero emissions by 2050 is the optimal pathway to minimise climate-related risks and losses. Under the Phase IV Current Policies scenario (albeit not yet accounting for all physical hazards and potential transmission channels), the modelled impacts suggest a loss up to 14%¹⁸ of GDP by 2050 relative to prior trends, compared with a potential 7% reduction in GDP under the net zero 2050 pathway¹⁹. These results provide clear guidance for policymakers and firms. To mitigate the worst impacts of climate change, all actors must intensify their efforts to reduce emissions across all scopes – in line with the 1.5 °C target of the Paris Agreement. Therefore, the NGFS scenarios produce results that differ from conclusions that are based on widely used Nordhaus-type models^{20, 21}. Damage functions, like

- 13 N.B., the NGFS Phase II scenarios which were the vintage available at that time. See www.ngfs.net/en/ngfs-climate-scenarios-central-banks-and-supervisors-september-2022.
- 14 <u>www.iea.org/reports/global-energy-and-climate-model.</u>
- 15 Consequently, the data for individual countries, derived through a downscaling process, may not fully capture local conditions and dynamics. In addition, Emerging Markets and Developing Economies (EMDEs) frequently experience gaps in input datasets, which may require further customization of the model setup.
- 16 <u>www.ngfs.net/ngfs-scenarios-portal/faq/</u> & <u>Current climate scenario analysis exercises may understate climate exposures and vulnerabilities, warn FSB and NGFS Financial Stability Board</u>.
- 17 See for example Projections and Uncertainties about Climate Change in an Era of Minimal Climate Policies (aeaweb.org).
- 18 The NGFS is currently considering a new damage function, capturing more effect from climate change, that would increase substantially this number.
- 19 www.ngfs.net/sites/default/files/media/2023/11/07/ngfs_scenarios_technical_documentation_phase_iv.pdf.
- 20 DICE/RICE models developed by Nordhaus (https://williamnordhaus.com/dicerice-models) are widely used to assess the impacts of climate change on the economy. The models and their conclusions are subject to criticisms, for instance, https://williamnordhaus.com/dicerice-models) are widely used to assess the impacts of climate change on the economy. The models and their conclusions are subject to criticisms, for instance, https://williamnordhaus.com/dicerice-models) are widely used to assess the impacts of climate change on the economy. The models and their conclusions are subject to criticisms, for instance, https://www.lse.ac.uk/granthaminstitute/news/a-nobel-prize-for-the-creator-of-an-economic-model-that-underestimates-the-risks-of-climate-change/.
- 21 For comparison between different damage estimates and the NGFS (Phase II) see ngfs.net/sites/default/files/media/2021/08/27/ngfs climate scenarios phase2_june2021.pdf.

those used by Nordhaus, are often assumed to capture all potential damages from climate change. Within the NGFS framework, however, the damage function is assumed to account only for damages from chronic physical risk, while losses from acute physical risk are considered separately. In addition, the NGFS does not provide statements on "optimal" warming levels, as it recognises that the non-exhaustiveness of climate change impact analysis inhibits fully accurate conclusions regarding this issue. Nevertheless, it must be noted that NGFS scenarios produce results that are in line with international climate consensus²² in the sense that they estimate total economic losses under "Orderly Transition" scenarios (which limit warming levels to below 2 °C) to be much lower than those incurred under "Hot House World" scenarios, which present warming levels well above this 2 °C threshold.

Recognising the frontier nature of climate scenario modelling, the NGFS incorporates feedback from industry and the wider climate ecosystem. The close collaboration between academic partners from worldleading institutes and practitioners in the financial sector is unique from a global perspective and promotes capacitybuilding in financial institutions. This also encompasses surveys among climate scenario users, which include financial authorities and private firms, as well as bilateral engagement with firms taking part in scenario analysis exercises²³. Drawing on feedback with respect to the future potential of carbon capture and storage (CCS) technologies²⁴ the Phase IV scenarios published in November 2023 reflect a more limited scope for the potential future use of CCS, as a result of which direct air carbon capture and storage (DACCS) technologies have been excluded altogether (although potentially useful, these technologies appear too uncertain at this juncture to be incorporated meaningfully within a scenario)²⁵. The latest vintage also extends the coverage of physical impacts while also reflecting the most up-to-date trends in renewable energy technologies. Moreover, it accounts for political and economic conditions becoming increasingly disorderly, which in turn has an impact on future transition pathways.

3. What are the main use cases of the NGFS scenarios and in which cases might tailoring be necessary?

The NGFS scenarios have served as a foundation for exploratory climate risk analysis exercises by central banks and supervisory authorities across multiple **jurisdictions.** As risks to the financial sector and the macroeconomy from climate change are pressing, the NGFS has moved ahead quickly to produce foundational scenarios. In doing so, the NGFS has recognised that further developments and refinements would be needed in future phases as methodologies and capabilities continue to advance. These scenarios have enabled a diverse set of users - often extending beyond central bankers and supervisors - to start developing their analytical capabilities, identify key data and technical gaps, and begin to size climate-related risks facing the financial sector and the wider economy. In this way, the scenarios provide a starting point for analysis that users should supplement as needed for their specific objectives.

A joint survey conducted across 36 jurisdictions by the Financial Stability Board (FSB) and the NGFS found that, for financial authorities, climate scenario analysis typically serves multiple objectives. The most common of these include assessing climate risks to financial stability, developing internal scenario analysis capabilities, assessing climate impacts on individual financial firms and facilitating dialogue with industry on climate-related financial vulnerabilities. More than half of surveyed authorities that have used the NGFS scenarios have refined their analyses through further adjustments – such as by generating additional parameters to enhance granularity or estimating additional variables not provided by the NGFS. For example, the Monetary Authority of Singapore extended its analysis

²² In its 6th assessment report, the IPCC stressed with high confidence that risks and projected adverse impacts and related losses and damages from climate change escalate with every increment of global warming, while the likelihood of abrupt and/or irreversible changes and the probability of low-likelihood outcomes associated with potentially very large adverse impacts increases with higher global warming levels. See https://www.ipcc.ch/report/ar6/syr/.

²³ See for example <u>Climate Scenario Analysis by Jurisdictions: Initial findings and lessons – Financial Stability Board (fsb.org)</u>; <u>CFRF Guide 2022: Scenario Analysis – financial firms (fca.org.uk)</u>.

²⁴ reclaimfinance.org/site/wp-content/uploads/2021/08/NGFS Climate Scenarios Analysis EN.pdf.

²⁵ www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_for_central_banks_and_supervisors_phase_iv.pdf.

by incorporating estimates of acute physical risks calibrated from damages associated with past flooding events in the South-East Asia region²⁶. In its second economy-wide climate stress test²⁷, the European Central Bank combined the NGFS scenarios with updated macroeconomic projections and more granular data on energy. Similarly, the Bank of England adapted the NGFS scenarios with bespoke adjustments to conduct its Climate Biennial Exploratory Scenario²⁸.

Financial firms use the scenarios, in addition to regulatory climate exercises, for a variety of objectives, including risk identification, financial risk assessment, and in some cases assessing the alignment of a portfolio to a particular temperature pathway. Thus, the scenarios can provide input for use cases such as strategy development and climate-related financial disclosures. In addition, the results of scenario analysis have led some firms to update their products, services and operational strategy²⁹. One example of an innovative application built on the NGFS scenarios is the Climate Narrative Tool developed by the Climate Financial Risk Forum in the United Kingdom to support industry users by summarising relevant climate-related risks and opportunities based on their business activities, products and existing exposures³⁰.

Another example is the Energy Climate Scenario Catalogue, which is published by the World Business Council for Sustainable Development and which enables businesses to conduct strategic climate resilience assessments, as well as explore transition pathways³¹. Lessons learnt from such exercises emphasise the need for firms to use scenario analysis and continue refining their capabilities when assessing their vulnerabilities to climate-related risks. However, further work would be required for scenarios to become suitable for internal stress testing, with the majority of firms surveyed in the United Kingdom acknowledging that several potential sources of climate risk that could present a material threat are not fully represented under the scenarios³².

As outlined in this paper, NGFS scenarios present only a limited yet credible set of pathways. These scenarios do not necessarily represent the most likely or most extreme potential outcomes. This is why scenarios will not always map to specific user objectives. Hence, scenario users should seek to tailor their analyses to suit their needs and determine which additional risk assessment tools and scenario calibration may be required. The main areas to consider are indicated in Table 1 below³³.

 $^{26\ \}underline{www.fsb.org/2022/11/climate-scenario-analysis-by-jurisdictions-initial-findings-and-lessons/.}$

²⁷ www.ecb.europa.eu/pub/pdf/scpops/ecb.op328~2c44ee718e.en.pdf?7793485730460e4e0b4e170237eb7429.

²⁸ www.bankofengland.co.uk/stress-testing/2021/key-elements-2021-biennial-exploratory-scenario-financial-risks-climate-change.

²⁹ Based on the GARP's Fourth Climate Risk Management Survey. CFRF Guide 2022: Scenario Analysis – financial firms (fca.org.uk).

³⁰ Climate narrative (cgfi.ac.uk).

³¹ WBCSD updates the climate scenario analysis tool for companies to leverage in their climate-related financial disclosures – World Business Council for Sustainable Development (WBCSD).

³² CFRF Scenario Analysis: Learning from the 2021/22 Climate Biennial Exploratory Scenario (CBES) (fca.org.uk).

³³ Table 1 provides an overview of the areas in which users may need to adapt the scenarios. Further guidance on how to adapt the scenarios may be included in future NGFS releases.

Table 1 Areas in which users may need to adapt the overall intensity of the scenarios

Scenario element	Explanation
Tipping points	Tipping points, such as the collapse of the Antarctic and Greenland ice sheets, could result in potentially irreversible damages ¹ , and some tipping dynamics may have already been triggered. However, given the challenges inherent in quantifying their effects, as well as long timescales required for some of the most devastating impacts to materialise, climate scenarios which cover "only" a few decades are not best suited to account for their impacts ² . The scenarios provide "middle-of-the-road" pathways. To explore severe tail risk events especially over longer time horizons, users are advised to consider how they might be additionally impacted by these events and to adjust the scenarios accordingly.
Physical impacts	Phase IV of the scenarios covers both chronic and acute physical risk impacts from climate change, with four types of acute physical impacts currently being modelled: droughts, heatwaves, floods, and cyclones ³ . Although this may offer valuable insights, users may need to validate these results for their own jurisdiction ⁴ . Users need to additionally assess their exposures to other physical risks such as sea level rise and forest fires, as well as potentially persistent effects on some output variables. They could also consider supplementing NGFS modelling with additional datasets and modelling. ⁵
Societal impacts	Climate change can drive violent conflicts and mass migration ⁶ , but their potential impacts are not captured by the existing suite of scenarios. Users need to additionally assess their exposures to societal impacts that may result from climate change.
Compound risk	In its note on compound risks ⁷ , the NGFS recognises that climate scenario analysis of physical risks should go beyond considering climate-related shocks in isolation. Although the current NGFS scenarios do not include compound effects from multiple climate risks occurring either simultaneously or sequentially, the recent note provides initial guidance for an operational framework designed to incorporate compound risks in climate scenario analysis.
Calibration of physical damages	Calibration of estimated damages from temperature rises remains an area of ongoing research ⁸ . The NGFS seeks further refinements to the damage function for estimating chronic risk impacts underpinning the scenarios, with a possible update in 2024. The current damage function only directly accounts for the impact of mean temperature rise, but lacks elements such as persistence effects or the impact of changes in precipitation. Users need to consider whether the current damage function of the scenarios is appropriate for their goals, such as capturing tail risks.
Technology assumptions	Scenarios include assumptions about technological progress and clean energy deployments, as well as the potential for future carbon capture mechanisms. The NGFS continues to update these assumptions, including for example a reduced role for carbon capture and storage technologies, in particular Direct Air Capture (DAC), in the most recent Phase IV of scenarios reflecting the latest evidence. Users should be aware of these assumptions and consider whether more stressed scenarios assuming less technological progress would be more adequate for their goals such as capturing tail risks.
Government policy change	Government policies relating to climate and energy change dynamically, and therefore are only captured by the scenarios with some lag and at a more generalised level, using shadow carbon prices as a proxy. Users should be aware of these assumptions and consider where they may face specific risks – or opportunities – reflecting the latest policy developments in their jurisdiction.
Financial sector	The NGFS IAMs do not model the financial sector in their framework. This means that the optimising agents in the scenarios are not affected by capital availability or a potential financial crisis leading to a credit crunch hindering the transition. For its first vintage of short-term scenarios, the NGFS is paying special attention to the inclusion of the financial sector and its potential transmission channels to the real economy.
Other	Since the scenarios can be used for many different use cases, there may be aspects other than the ones listed above that call for user adaptation. For instance, the shadow carbon price could be downscaled to higher sectoral granularity, in which higher carbon prices can be applied to specific sectors of interest. Other sectoral, geographical, or temporal features can also be considered while adapting the scenarios to a particular use case.

- 1 www.ipcc.ch/sr15/chapter/chapter-3/.
- 2 The NGFS has recognised risks of tipping points in its original <u>Guide to climate scenario analysis</u> (June 2020) while pointing out these are not captured by the models. See also: 'We are aware of the criticism': The NGFS on its next phase of scenarios: Environmental Finance (environmental-finance.com).
- $3\ \underline{www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_for_central_banks_and_supervisors_phase_iv.pdf.$
- 4 Users may consider further adjustments where the impacts of natural hazards were modelled at a regional level and then downscaled to national level.
- 5 Granular physical risk impact projections in line with the NGFS scenarios can be retrieved from the Climate Impact Explorer: https://climate-impact-explorer.climateanalytics.org/.
- 6 https://unfccc.int/news/conflict-and-climate.
- 7 www.ngfs.net/sites/default/files/media/2023/11/07/ngfs_compound_risks_implications_for_physical_climate_scenario_analysis.pdf.
- 8 See 2. Types of uncertainties and understanding of risks of losses and damages | Managing Climate Risks, Facing up to Losses and Damages | OECD iLibrary (oecd-ilibrary.org).
- 9 For a further evaluation, see www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesSeriadas/DocumentosOcasionales/23/Files/do2302e.pdf
- $10 \ \underline{ngfs.net/en/communique-de-presse/ngfs-publishes-conceptual-note-short-term-climate-scenarios}.$

Consistent with best practice, scenario users should provide a narrative or qualitative explanation of what their exercise is designed to achieve and how their scenario adaptation achieves that. Where it is not possible to do this, users should challenge themselves on whether the scenario calibration is appropriate for their objectives. The further out in time, the greater the uncertainty associated with modelled impacts, and the potential for tipping points and tail risks materialising along the continued warming pathways inevitably increases. Given the remaining uncertainty, users – and particularly financial firms should take a precautionary approach to climate risks. They should focus on developing and implementing transition plans to align their operations with an orderly Paris-aligned transition. Scenario analysis can usefully underpin risk mitigation actions that should form part of an entity's transition plan³⁴.

The scenario toolkit can also be adapted to analyse near-term impacts of various potential future outcomes, with direct relevance for three-year to five-year horizons, which are more typical for monetary policymakers, business cycle planning and financial risk analyses (e.g. stress tests). With the increasing frequency and intensity of extreme weather events – in conjunction with other risks such as the heightened volatility and regional uncertainty of fossil energy supply – improving the analytical toolkit to analyse near-term climate-related impacts has become more important³⁵. The scientific evidence is mounting that the world may exceed the

1.5 °C warming threshold for at least one year within the next five years³⁶. With a view to complementing the utility of long-term narratives, the NGFS has therefore started work on developing short-term climate scenarios. This approach also overcomes some limitations of long-term scenarios, by better capturing shocks with only near-term impacts (such as confidence shocks), allowing for non-linearities in the transmission of shocks and sounder use of static balance sheet or portfolio assumptions³⁷.

Conclusion

The NGFS scenarios are frontrunners in their field by setting standards for industry and providing a starting point for forward-looking analysis to tackle the uncertainty characterising climate-related physical and transition impacts. They are not forecasts, however, and the results of their modelled pathways come with acknowledged limitations. Scenario pathways help users to conceptualise various possible future outcomes and the range of risks they pose. Users should use the scenarios as a foundation for their work to build upon, while recognising where they need to supplement their risk management with further analysis. Most importantly, the scenarios find that an early and orderly transition minimises physical and transition impacts on the economy and consequently also on monetary and financial stability. Financial firms, central banks and supervisors, as relevant within their responsibilities, therefore have a shared interest in contributing to the timely mitigation of climate change³⁸.

³⁴ https://transitiontaskforce.net/wp-content/uploads/2023/11/TPT-Banks-Sector-Guidance.pdf.

^{35 &}lt;a href="https://economy-finance.ec.europa.eu/economic-forecast-and-surveys/economic-forecasts/autumn-2023-economic-forecast-modest-recovery-ahead-after-challenging-year_en.">https://economy-finance.ec.europa.eu/economic-forecast-and-surveys/economic-forecasts/autumn-2023-economic-forecast-modest-recovery-ahead-after-challenging-year_en.

 $^{36\ \} According to the World \ Meteorological \ Organization. \ See \underline{www.un.org/en/climatechange/reports}.$

 $^{37 \ \}underline{ngfs.net/sites/default/files/medias/documents/conceptual-note-on-short-term-climate-scenarios.pdf.$

³⁸ ngfs.net/sites/default/files/medias/documents/ngfs climate scenarios for central banks and supervisors phase iv.pdf.

Frequently asked questions

Do scenarios provide an off-the-shelf package that my organisation can use without alterations?

No, scenarios are a key tool for providing the basis for the analysis of climate risks but should not be regarded as an end-state toolkit. Different users have different needs and therefore they need to adapt their analyses accordingly. Users may need to review assumptions and validate scenarios for jurisdiction(s) of interest to ensure that they are applied appropriately and interpreted in such a way as to recognise uncertainties and limitations.

What are best practices that users should follow when using the scenarios for financial risk assessment?

Best practices for users of scenarios include providing a narrative or qualitative explanation of what their exercise is designed to achieve and how the calibration of the scenario achieves that. Where it is not possible to do this, firms should challenge themselves on whether the scenario calibration is appropriate to their objective.

Do scenarios provide a comprehensive picture of climate-related risks?

Scenarios provide a robust albeit non-exhaustive picture of potential risks and the accompanying material acknowledges the types of climate-related impacts and dynamics that are not captured at present. It is important to note that the scenarios are not forecasts, but instead outline plausible potential future outcomes *given* the assumptions outlined.

What are the key areas of analysis that might require further adaptation when using the scenarios?

Users could account for climate risks that are not currently captured by the scenarios. These include physical impacts that are not modelled at present (sea level rise, for example), climate tipping points and societal impacts resulting from climate change. Users should also recognise the uncertainty regarding the calibration of damages and intensity of future extreme weather events. Further disaggregation of the scenarios at a more granular sectoral and/or geographical level could also be advisable for certain types of assessments.

How would the NGFS suggest that institutions adapt the scenarios if they so choose?

How to adapt the scenarios depends on the country context, purpose of the exercise, and the chosen methodology. A non-exhaustive list of options is provided below, but institutions can consider many other approaches to use and adapt the scenarios.

Users could consider adding hazards that are relevant to their scope, such as wildfires, for dense forestry areas, or coastal flooding, for coastal areas. In addition, they could consider increasing the severity of physical damages to explore tail risk events. Changing the timeframe of the exercise could have a similar impact, as physical risk impacts in the distant future are likely to be more severe than those with a short-term horizon, which are typically used in risk assessments. From the perspective of a longer timeframe, they might also opt to include a tipping point in their analysis and explore the potential impacts of such risks materialising. Moreover, users could combine, align, or change existing scenarios to develop a custom scenario that suits their needs best.

How could the NGFS scenarios be used for Value at Risk (VaR) assessments?

Financial institutions often require an extensive array of scenarios for value at risk assessments. Although the NGFS scenarios provide only a limited set of plausible pathways, they could serve as a valuable starting point for such assessments. Initially, users might enhance the seven NGFS scenarios by incorporating climate scenarios developed by other organizations. The Intergovernmental Panel on Climate Change (IPCC), as part of its Sixth Assessment Report, compiled numerous climate scenarios globally³⁹. It is important to note, however, that these scenarios may not consistently include variables pertinent to the financial sector. Additionally, the NGFS scenario dataset offers users multiple alternative projections for each scenario through physical impact estimates across various percentiles of modelled probability. Nevertheless, this diverse range of estimates is exclusive to physical risk impacts, as only one value is available for each scenario concerning transition impacts.

³⁹ These scenarios' data can be retrieved from the IIASA AR6 Scenario Explorer and Database: https://iiasa.ac.at/models-tools-data/ar6-scenario-explorer-and-database.

How does the NGFS plan to continue refining and improving the scenarios?

The NGFS, together with its members and research consortium, continuously explores ways in which it can improve its scenarios. This includes an annual update in which not only the latest climate and economic data, but also the most recent climate policies and pledges, are added. Moreover, the models supporting the scenarios, including the IAMs and physical risk models are regularly reviewed and updated to newer versions, thereby improving their accuracy and robustness. In addition, a new chronic physical risk damage function is being considered, that would, once implemented, cover chronic physical risk impacts from climate change much more holistically. Regarding nature-related risks, the NGFS is already exploring, with a dedicated Task Force, the economic impact arising from nature and biodiversity losses. This work could eventually also find its way into the NGFS climate scenarios.

Note that the NGFS scenarios are being developed in step with the latest advancements in climate modelling research. This remains a vastly unexplored field of research that is fraught with many uncertainties. Despite increasing efforts, new additions take months – and often years – to be reviewed (including by the scientific community) and subsequently adopted. As the enhancements of each successive vintage of the scenarios show, the NGFS scenarios will continue to expand their scope and coverage. Although some limitations will remain unavoidable aspects of climate scenarios in the foreseeable future, the current set of NGFS scenarios already offers a valuable and continuously improving framework for climate scenario analysis. In addition, the NGFS will soon start to develop short-term scenarios to complement the existing (long-term) scenarios. The new scenarios will focus on potentially severe near-term climate-related risks and can be used for climate stress tests and similar exercises. A conceptual note was published earlier in 2023, delineating the concept, narratives, and potential methodologies underlying these scenarios⁴⁰.

How can the NGFS scenarios be applied by insurance supervisors?

Similarly to other financial sectors, the NGFS scenarios can be applied within the insurance sector. As noted by the International Association for Insurance Supervisors (IAIS), insurance supervisors are able to choose between using "ready-made scenarios (such as those developed by the NGFS), modifying ready-made scenarios [or] developing reverse stress tests".

An illustrative example of this was the Bank of England's Climate Biennial Exploratory Scenario (CBES). In this case climate scenarios were based on the NGFS's Net Zero 2050 and Current Policies scenarios, but with modifications to align with the specific design objectives of the exercise. For example, to promote capacity building, insurers were invited to use any physical risk data sources but were required to calibrate their scenarios to direct physical variables to ensure a degree of consistency.

More information on the use of the NGFS scenarios by insurance supervisors can be found in the IAIS's recent draft application paper on climate risk scenario analysis in the insurance sector⁴¹.

⁴⁰ www.ngfs.net/en/conceptual-note-short-term-climate-scenarios.

⁴¹ www.iaisweb.org/2023/11/iais-launches-public-consultation-on-climate-risk-supervisory-guidance-market-conduct-and-scenario-analysis/.

Acknowledgements

This explanatory note "NGFS scenarios: Purpose, use cases and guidance on where institutional adaptations are required" is a collaborative effort under the Workstream on Scenario Design and Analysis. As per all NGFS publications, this document is non-binding and does not necessarily represent the specific views of any member institution.

This document was prepared under the auspice of Livio Stracca (European Central Bank), in his role as Chair of the Workstream with a substantial support from the Bank of England. It relies on the analysis and drafting work of a dedicated team from both institutions. The NGFS is especially thankful to the drafting team comprising Senne

Aerts, Martina Spaggiari and Agnieszka Trzcinska (European Central Bank), Christ Faint, David Gayle, Lukasz Krebel and Danae Kyriakopoulou (Bank of England), with support from the NGFS Secretariat – Alessandro Cavallero (Banca d'Italia), Gaya Aiche, Paul Champey and Li Savelin (Banque de France).

The NGFS is also grateful to the following members for providing comments on the document: Wei Han Ang (Monetary Authority of Singapore), Michaela Dolk, Nepomuk Dunz and Martijn Regelink (World Bank), Sigurður Freyr Jónatansson (Central Bank of Iceland), Philipp Haenle (Deutsche Bundesbank), Maria Nieto (Banco de España) and Roberto Reynoso (Banco de México).



