

Network for Greening the Financial System  
Technical document

# Monetary policy and climate change

Key takeaways from the membership  
survey and areas for further analysis

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## Joint foreword by Ravi Menon and James Talbot

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**T**he world is changing. The recent global energy price shock underscored the need to accelerate the transition away from fossil fuels towards greener and more sustainable sources of energy. That transition to a low-carbon economy and the growing economic impacts from climate change represent a major transformation of our economies. We have also seen the intensification of extreme weather events such as devastating floods, cyclones, droughts and heatwaves affecting livelihoods across continents. As these shocks become more frequent, they are likely to have important macroeconomic consequences, affecting both the two- to three-year horizon that monetary policy typically focuses on, as well as the medium-to-longer term.

The transition will cause relative price shifts and impact consumption and investment flows. Monetary policymakers will need to consider the impact of these shocks as their effects on growth and inflation become more evident. Different economies will also be impacted differently, and global interlinkages mean that international spillovers will add a further layer of complexity.

We need a systematic analytical framework to properly understand what climate change and the net-zero transition mean for our economies – and the households, businesses and policymakers that operate within it.

Our understanding in this space is still at an early stage, and our modelling toolkits need significant enhancements to capture climate-related effects. But central banks cannot wait for complete clarity over the path of climate change and policies or for a "perfect" macroeconomic-climate model of our economies to be developed. We have to pool our resources and seek out opportunities for learning, knowledge sharing, and exploration of these issues.

To inform this work, we conducted a survey of the NGFS membership to better understand members' current state of thinking and progress in the areas covered by the mandate, identify where further work is planned and where collaboration would provide the most benefit to fill knowledge gaps, build toolkits and share learnings. This survey represents the most extensive review of central bank thinking ever undertaken in this important space. We are delighted to share the results of that survey in this report.

These survey results will form the foundation for the next stage of the NGFS' ambitious work programme on monetary policy in the coming years. The work should equip central banks to better understand these shocks and their impact on policy-making. We hope it will also be of use to other policymakers and actors who need a clearer understanding of the macroeconomic consequences of climate change.

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## Executive summary

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**Climate change and the transition to net zero is already affecting our economies.** This is clear from the responses to a survey carried out by the NGFS during the second half of 2022.

The survey results incorporate feedback from almost two-thirds of the NGFS' membership and provide a representative sample across economic status and geographic distribution. This survey of central bank views provides the most comprehensive picture to date of how climate change and how the net zero transition are affecting economies. It also complements previous analysis by the NGFS on how climate change is likely to impact the conduct of monetary policy ([Climate Change and Monetary Policy: Initial takeaways](#), June 2020) and a preliminary assessment of various options to adapt monetary policy operations to climate change ([Adapting central bank operations to a hotter world: Reviewing some options](#), March 2021).

**Half of central banks surveyed indicated that their economies had already experienced damage caused by chronic physical impacts of climate change over the last decade**, while the proportion reporting damages from acute climate events was even higher (around 70%).

**Governments around the world are the primary actors when it comes to setting and implementing climate policies. They have started to signal their intent to transition their economies towards net zero** and to enact policies to support these objectives. Reflective of this, **around one-third of central bank respondents** – particularly in advanced economies – **noted that their economies have already been experiencing the macroeconomic impacts of transition**, while around half of the respondents expect the transition to have an impact over both the monetary policy horizon and medium-to-long term.

**Unsurprisingly then, understanding the macroeconomic impacts, as well as what they could imply for the setting of monetary policy, has become an area of increasing priority amongst central banks.** More than half of survey respondents – evenly split between advanced economies (AEs) and emerging markets and developing economies (EMDEs) – either have work underway or plan further analysis to understand the effects of physical impacts of

climate change on their economies. A similar proportion (though more concentrated amongst AEs) have conducted analyses to understand the effects of transition impacts. And while most central banks reported that they do not currently have macroeconomic models embedded into their existing monetary policy setting process that adequately capture the complexity of *both climate and related economic effects*, many have analysed at least one aspect of physical or transition impacts using their existing modelling toolkit.

On the **implementation of monetary policy**, around 40% of respondents have already taken steps to integrate climate change considerations into their operational framework and many are considering further steps, in particular to protect their own balance sheets from climate-related financial risks. To this end, central banks have implemented a variety of approaches, reflecting specific mandates and policy objectives, and have signalled a desire to share experiences among peers and draw lessons from efforts so far.

**However, taking climate change into account in the context of monetary policy is still at an early stage and while some important steps have been made, the responses to the survey identify a common need among central banks to further improve their policy toolkits.** In terms of the macroeconomic effects of physical impacts, respondents expressed strong appetite to better understand how to approach and quantify the impacts on key variables and identify relevant transmission channels. Reflecting the diversity of economic structure, paths to net zero and technological advancement, central banks have heterogeneous requirements in understanding the impacts of transition. Underpinning this work requires advanced modelling capabilities. Reflective of the key challenges identified – such as limitations in expertise and high costs of upfront investment – there is a strong interest among central banks to come together to fill the relevant gaps and help to push out the frontier.

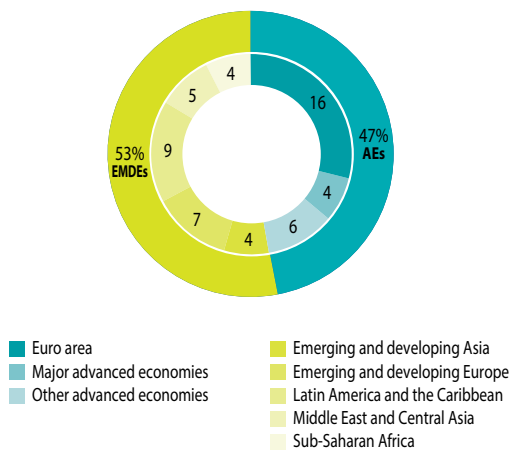
Building upon its previous works, **the NGFS will continue to use its unique position as a collective source of expertise and learning in order to fill this gap and help equip central banks with the tools they need to understand and address climate change and the transition to net zero in the context of monetary policy.**

# Introduction

Given the relative infancy of work to date on considering monetary policy in the context of climate change and the transition to net zero emissions, a comprehensive and representative survey of the NGFS membership was undertaken to inform the future work of the NGFS in this area, under the auspices of the “Monetary Policy” workstream. Notwithstanding varying degrees of progress over recent years, the survey confirmed that macroeconomic effects of climate change and its impact on monetary policy remain relatively new areas for central banks to explore.

The survey was conducted between July 2022 and September 2022, with feedback from 55 out of 88 NGFS members that are central banks as well as from three observers. This represents almost two-thirds of the NGFS central bank membership (representing over four-fifths of global GDP) with broad-based representation across all geographies and an equal split of responses between AEs and EMDEs (Chart 1).<sup>1</sup>

Chart 1 Breakdown of respondents by stage of economic development and region<sup>2</sup>



Note: Outer ring shows total replies to each question by economy type (as a percentage of all replies given). Inner ring shows breakdown of the replies by geographical location (with the number of replies received from central bank respondents).

This report sets out the main findings from the survey and outlines priority areas for progress to address the challenges faced by central banks. This report explores the macroeconomic implications (Sections 1 to 3), before turning to monetary policy operations considerations (Section 4):

- Section 1: Understanding the macroeconomic effects of physical impacts;
- Section 2: Understanding the macroeconomic effects of the transition to a net zero economy;
- Section 3: Integrating climate impacts into macroeconomic models and analytical approaches;
- Section 4: Integrating climate considerations into monetary policy operations.

The closing section summarises the next steps from here and areas for future work.

As set out in the 2020 NGFS report on Climate Change and Monetary Policy, climate change and its mitigation will increasingly affect the key macroeconomic variables at the centre of the conduct of monetary policy. The latest survey results show that around two-thirds of central bank respondents anticipate that the impacts of climate change and the transition will affect the monetary policy transmission mechanism in their economies and three-quarters anticipate it will give rise to trade-offs that monetary policymakers will have to confront. However, understanding these macroeconomic underpinnings is an area where analysis remains at an early stage and toolkits are incomplete. Unsurprisingly then, there was a clear consensus in the survey responses on the **need to better understand both the physical and transition-related effects of climate change on macroeconomic outcomes first, as a necessary foundation for then considering the implications for the conduct of monetary policy.** The survey also highlights the importance of striking the right **balance between making analytical progress and knowledge sharing.**

1 Please note that where shares of survey responses are provided within the text, these represent the share relative to the full sample of respondents so as to allow for a clear comparison across questions, however, each responding institution may not have responded to every question.  
 2 Grouping is based on the International Monetary Fund’s classifications.

Within this, the priorities identified in the survey present a strong motivation for seeking to deliver on two overarching goals: (i) to leverage the heterogeneity – in terms of progress and understanding to date – among central banks so as to share knowledge and (ii) bring all central banks up to a common starting point, while also using the unique position of the NGFS as a collective source of expertise to help to close identified gaps and push forward the analytical frontier.

Regarding monetary policy operations, the survey responses put a heavier focus on knowledge sharing. Building on the 2021 NGFS report, Adapting central bank operations to a hotter world – which set out options for how central banks could integrate climate-related considerations into their operations – the focus of this work is to ensure central banks leverage learnings from each other in their actions in this space to date and share experiences, with a large emphasis on the practical lessons learnt.

# 1. Understanding the macroeconomic effects of physical impacts

**Most central banks reported that their economies had experienced damage from physical impacts<sup>3</sup> over recent years**, with acute weather events being the most prevalent source of economic damage. For example, over half of respondents noted damages from climate-related events such as domestic droughts and floods, and one-third from domestic wildfires.

Chronic impacts have also been affecting economies, with around half of respondents citing impacts from gradual temperature rises and one in four citing impacts from rising sea levels.

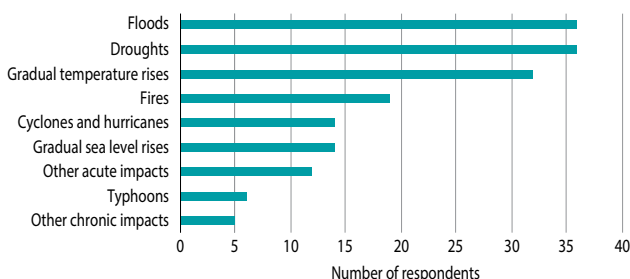
According to the survey results, most of the analysis that has occurred so far among respondents has been on domestic events and trends (79%), while a smaller share has explored impacts stemming from abroad (21%). In addition, central banks tended to report a higher degree of uncertainty on how events and trends from abroad might affect their own economies compared with physical impacts taking place domestically (respondents associated around 80% of uncertain effects to events and trends from abroad) and noted that international angles were an area that needed to be better understood.

A common theme highlighted by the survey is that central banks want to better understand and be able to quantify physical impacts on key variables, as well as identify relevant transmission channels, especially given the threat of ever stronger and more frequent climate-related physical shocks on the horizon.

## Central banks' experience with physical impacts

**The survey responses highlight differences in how physical impacts have materialized across economies**, despite a broadly similar proportion of AEs and EMDEs indicating that their economies have already been affected by physical impacts of climate change (both around three-quarters) (Chart 2).

Chart 2 **Macroeconomic impacts of the physical consequences of climate change (observed over the past 5 to 10 years by respondents)**



Note: Respondents could select all applicable options.

The number of EMDEs citing adverse impacts stemming from gradual sea level and temperature rises as well as spillovers from extreme weather events abroad is twice as large as for AEs. On the other hand, AEs more commonly cited impacts associated with acute events, such as wildfires.

**Looking ahead, central banks expect their economies to become increasingly vulnerable to physical risks over time.** Around 70% of respondents cited concerns over negative economic effects of more widespread acute physical risks over time, such as droughts and floods.

## Central banks' analysis to date

Given experience to date and expectations that the physical impacts of climate change will intensify, **close to half of survey respondents (47%) have already conducted analytical work in this area, while even more (56%) are conducting work (or plan to do so) to enhance their understanding of the macroeconomic effects going forward.**

In terms of chronic impact analysis, further analysis on gradual temperature rises was a key area of interest for the largest number of central banks (around one-third). Alternatively, only around one-fifth of central banks also plan to study the effects of gradual sea level rises.

<sup>3</sup> Physical climate risks are either acute or chronic. Acute risks include droughts, floods, extreme precipitation and wildfires. Chronic risks include rising temperatures and sea levels.

In terms of acute impact analysis, current and future plans are mainly focused on better understanding the macroeconomic effects of floods (one-third of central banks), droughts (one-quarter), as well as cyclones and hurricanes (one-tenth). However, overall EMDEs expressed a greater interest in exploring the impact of chronic effects such as gradual sea level rises, while AEs were more interested in acute effects such as wildfires.

**Most central banks suggested that the key obstacles limiting research on the macroeconomic consequences of physical impacts are data gaps and limited knowledge and research capabilities.** The lack of quality granular data was mentioned by almost all survey respondents, although many also cited lack of technical expertise. Survey respondents also mentioned challenges related to the modelling of physical risks and the identification and subsequent quantification of key transmission channels, as well as better understanding potential international spillovers.

### Areas for furthering the analysis of physical impacts on monetary policy

**To address the gaps and challenges identified from the survey and recognising that work to bridge data gaps is already under way, there is a need to support**

**central banks in their efforts to better understand the physical impact of climate change on their respective economies.** Such support could help to clarify what central banks need to know about the macroeconomic effects stemming from the acute impacts of climate change, in particular – capturing both domestic and international transmission channels – and their relevance to monetary policy. One central aspect of any work will be to ensure that it is readily adaptable and applicable to a wide range of country circumstances, in line with the broad membership of the NGFS.

**Future analysis should also support central banks from both a theoretical and quantitative perspective.** The ambition is to not only improve forecasts and scenario design over time, but to also identify gaps in knowledge and existing policy frameworks. Reflecting survey respondents' broad-based concerns about acute physical risks in the near term, an initial focus on acute or extreme weather events will pave the way for subsequent work focused on the possible implications for monetary policy as these shocks become more frequent and severe. Indeed, with extreme weather events expected to become increasingly correlated, and potentially reinforcing, over time, it may become more challenging for central banks to "look through" these effects as though they are temporary.



## 2. Understanding the macroeconomic effects of the transition to a net zero economy

As part of global efforts to achieve the Paris Agreement and limit global warming to 1.5°C, an increasing number of countries have been taking action, legislating targets and policies as well as committing to further ambition. The economic effects associated with the transition to net zero greenhouse gas emissions stem from three main drivers: climate policies; technological changes; and changing preferences. Cutting across all three drivers is uncertainty, which in the context of climate change and the macroeconomy is multi-faceted.

### Central banks' experience with transition impacts

**At present, many countries (35% of survey respondents) have already experienced different macroeconomic impacts associated with transition policies and expect these impacts to become more consequential over the monetary policy horizon (Chart 3).**

**Looking ahead, around half of survey respondents expect the net zero transition to have an impact on their economies across both the monetary policy horizon (typically two to three years) and the medium-to-long term (five to 30 years).**

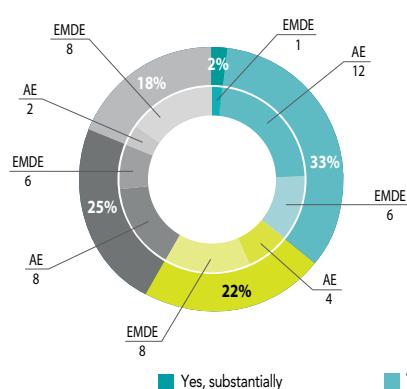
However, a considerable number of survey respondents (around a quarter) are uncertain about the effects of the transition over either time horizon.

Most central banks identified climate mitigation policies and/or technological changes as key drivers of macroeconomic impacts. Some respondents also indicated that preference changes among households and businesses and uncertainty regarding national-level transition plans themselves have had or are expected to have an impact on their economies.

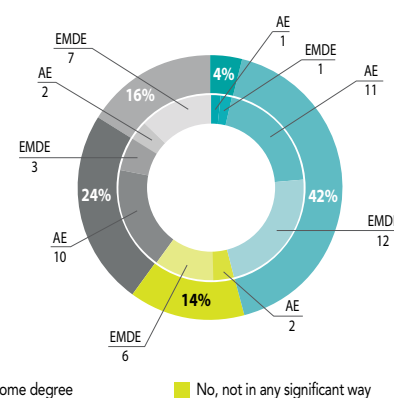
Given the scale of additional investment required to meet the Paris Agreement, central banks currently judge that the transition is having, and will have, the most substantial impact on investment (two-fifths of responses). This is followed by inflation (one-quarter), trade, GDP, labour market, fiscal balance (all around 10%), consumption (5%) and potential output (3%). Around two-fifths of central banks also mentioned that the transition could lead to changes in production and market structure across sectors, with a small share noting the possibility of spillovers from financial stability effects to the macroeconomy.

Chart 3 **Macroeconomic impacts of the net zero transition**

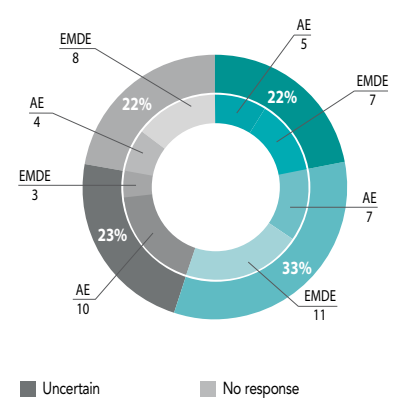
a) Has your macroeconomy been affected by the consequences of the low carbon/net zero transition over the past five years (including spillover impacts)?



b) How do you expect your macroeconomy to be affected by the consequences of the low carbon/net zero transition over the monetary policy horizon (including spillover impacts)?



c) How do you expect your macroeconomy to be affected by the consequences of the low carbon/net zero transition over the medium-longer term (including spillover impacts)?



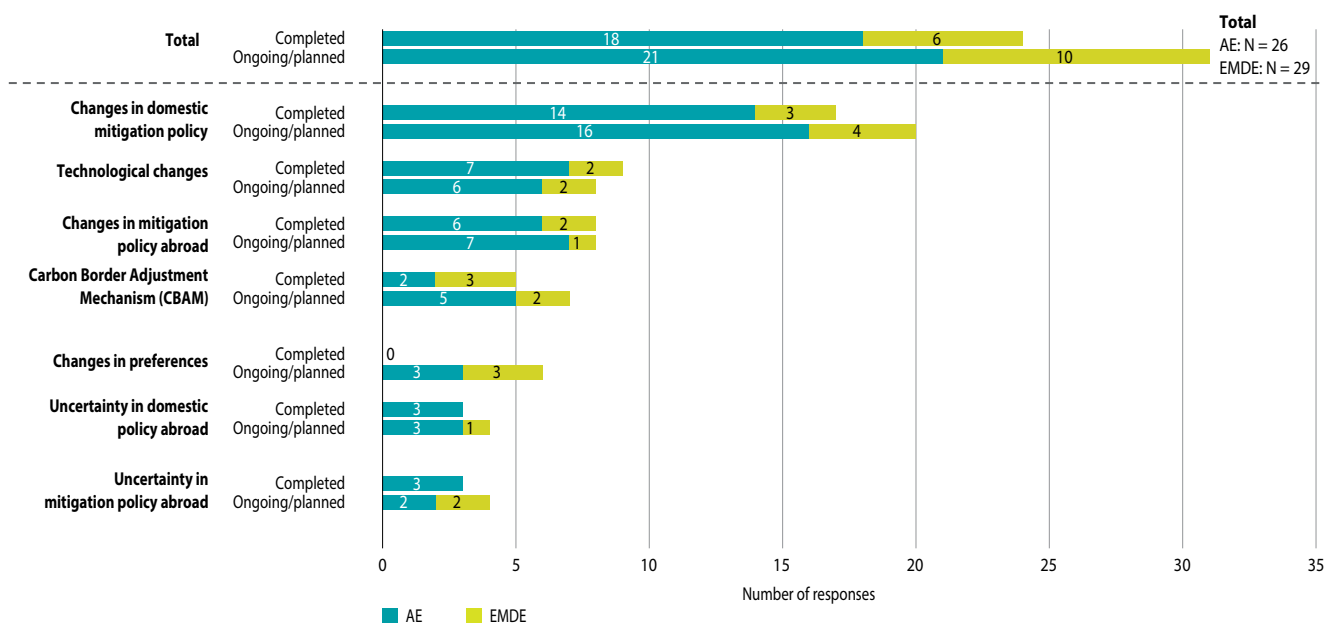
Note: Outer ring shows total replies to each question (as a percentage of all replies given). Inner ring shows breakdown of the replies by economy type (with the number of replies given for AEs and EMDEs).

Survey respondents also reported some opportunities. For instance, around one-third (especially in EMDEs) expect the transition to lead to an improvement in productivity, because of the combination of an overall increase in investment (due to large investment needs in low-carbon technologies as mentioned above) alongside the development of new technologies and new expertise. Moreover, a few noted that the transition could enable their economies to become less dependent on energy imports, thus contributing to improved trade balances and competitiveness.

## Central banks' analysis to date

**To date, close to half of central banks have conducted some analysis to understand the macroeconomic effects of transition impacts (two-thirds of which are AEs). Looking forward, over half of survey respondents have work underway or plan to perform further analysis (including four out of five responding AEs and one-third of responding EMDEs).**

Chart 4 Analysis on macroeconomic effects of transition by central banks



Note: Not all survey respondents responded to all questions. Some survey respondents with completed analyses may not perform analyses on the same topic moving forward. Thus respondents for "completed" and "ongoing/planned" within a single topic may or may not overlap.

Analysis has so far focused on domestic mitigation policies (e.g. carbon prices) and their effects within the boundaries of the economy (Chart 4).

In terms of time horizon, the analysis completed to date has focused on the medium-to-long term whereas analysis over the short and medium-term horizon is identified as a focus of interest for current or future work.

## Gaps and suggestions for further work

**The survey identified three main gaps in understanding the macroeconomic impacts of the net zero transition<sup>4</sup>:**

- Lack of expertise on climate-economic risks and/or macroeconomic models to analyse the potential impact of such risks (one-third of central banks);
- Lack of high quality and/or granular data (one-third of central banks);
- Lack of time and/or resources (around a tenth of central banks).

4 Survey respondents were allowed to indicate more than one gap.

Consistent with the emerging nature of this work and the variety of exposures to transition risks, there is a wide range of views on the aspects of transition worthy of further consideration.

While much of the existing research has primarily focused on the economic impacts of domestic climate policies, there is a growing interest among central banks to examine the international spillover effects of climate policies from other countries, including the impact of Carbon Border Adjustment Mechanisms (CBAM). Additionally, there is a keen interest in studying how the global transition to renewable energy and green investments affects macroeconomic outcomes, particularly in EMDEs. Central banks from AEs are also interested in investigating the effects of regulations and subsidies, as well as the interactions between climate and fiscal policies.

To fully comprehend the macroeconomic channels and variables impacted by climate policies, central banks recommended analysing their effects on inflation expectations, policy uncertainty, labour markets, potential output, in addition to the other key variables that are typically studied.

Finally, beyond climate policies, there is also a growing interest in studying the effects of technological advancements and changes in preferences, as well as the sectoral reallocation

of resources and economic frictions such as in the labour market. It is also important to consider the impacts of these transitions on the transmission mechanisms of monetary policy and on the natural rate of interest.

### Areas for furthering the analysis of transition impacts on monetary policy

Given the collective work in this area to date and in response to the gaps highlighted above, the NGFS will seek to establish a common foundation across central banks on the ways in which the path for climate mitigation policies might affect the economy, focused on the monetary policy horizon (typically around two to three years). To achieve this, the work will prioritise identifying what central banks need to know (characterised across dimensions such as variables, outputs, etc.). It will also produce a set of key insights on the channels through which the three major transition drivers (climate policy, technological change and changes in preferences and public attitude) and the uncertainty around them, will affect the economy and therefore monetary policy.

These efforts, as well as those to improve our understanding of the macroeconomic effects of physical impacts will be complementary and contribute to the NGFS work on scenario design and analysis, notably on short-term scenario development.

### 3. Integrating climate impacts into macroeconomic models and analytical approaches

#### Current state of modelling efforts

**While central banks recognise the importance of assessing the complex and diverse impacts of climate-related effects on the economy, existing tools to systematically study and model these effects in a monetary policy context need to be further developed.**

As a result, for the majority of survey respondents, climate considerations have not yet been formally included into the forecast models that support their monetary policy committees' decisions.

However, almost two-fifths of survey respondents have been able to make use of traditional macroeconomic models and tools to consider the implications of climate change and the transition to a net zero economy. Indeed, for many central banks the experience of the past year or so, with the sharp movements in energy prices, have provided a means to build up and/or reinforce existing capabilities to understanding the linkages between energy markets and the economy. More specifically, the survey found that around one-third of survey respondents (mostly from AEs) have found ways to incorporate physical and/or transition impacts into existing macroeconomic models – albeit this is an imperfect interim solution. Efforts to integrate climate-related aspects into existing models have been slightly more prevalent over the monetary policy horizon (typically two to three years) than over the longer term (five to 30 years). On the other hand, no survey respondent reported nowcasting of transition impacts while only a small share reported nowcasting of physical impacts (the majority of which were EMDEs).

Most central banks have not yet used **climate change scenarios** in the context of conducting monetary policy. However, survey respondents who reported using scenarios were interested in the impact on potential GDP, as well as other key variables such as inflation, asset prices and those relevant for monetary policy. The impacts on international commodity prices and key sectors (e.g. food and energy production) were also of interest among some respondents.

Central banks have drawn on a wide range of information to understand the physical and transition impacts, with around one-third citing the use of business surveys, outreach to climate experts and independent research. While most survey respondents have used these as complements to modelling efforts, some resorted to these approaches to compensate for the lack of available models.

**Overall, notwithstanding the challenges, drawing on existing modelling toolkits has still been beneficial in improving most central banks' understanding of the transmission channels via which physical and transition impacts affect the economy.**

#### Future plans and challenges

**Central banks are committed to improving their climate-related analytical capabilities but data availability and quality and integrating climate considerations into existing workhorse models remain key challenges.**

Going forward, four out of five central banks plan to further develop their analytical capabilities with around three-quarters intending to specifically improve their physical impact modelling capabilities, and two-thirds focused on transition impacts. While efforts are being pursued to improve partial equilibrium climate-macro analysis, just over half of central banks are also looking to build up capabilities to model the combined effects associated with both physical and transition impacts in a general equilibrium setting.

However, the survey replies also highlighted several challenges that central banks have been facing as they have sought to intensify their modelling efforts. Many reported challenges around using traditional models to fully assess the physical and transition impacts on their economies. Challenges are also expected to arise from gaps in our collective understanding of how the key channels of transmission are affected and therefore whether or not these are adequately captured by our existing models.

Examples of such challenges include:

- **Data availability and quality:** many data gaps exist, which make modelling relationships and impacts on the economy challenging. This includes the scarcity of disaggregated data at a granular/sectoral level such as: (i) energy usage by sector, (ii) carbon intensity of imports and exports and (iii) firm capital disaggregated into green and non-green investments. Another example is identifying which assets are likely to be stranded or lose significant value, in the event of materialized physical and/or transition risks, further complicating efforts to capture the financial impacts and their linkages back to the real economy.
- **The need to develop or adapt commonly used models:** most workhorse macroeconomic models currently used across central banks have been calibrated based on historical average relationships between key macro variables over the business cycle. But if the transition to net zero entails a permanent change to the steady state of the economy, these models are likely to struggle to account for transition-related sectoral shifts, non-linearities and the effects of uncertainty related to climate policy and green technologies. In addition, larger and more frequent climate-related weather events will require models with well-articulated supply sides. The current generation of Dynamic Stochastic General Equilibrium (DSGE) models typically used by central banks in the context of monetary policy analysis are frequently linearised and exclude (by construction) a role for nonlinearities or uncertainty. Moreover, they tend to feature a high level of aggregation, which makes them less suitable for analysing sectoral adjustment processes. Permanent shifts in the allocation of factor inputs are also not well modelled.

These modelling challenges are further amplified when projecting beyond the medium-term horizon.

## Areas for furthering the analysis of macroeconomic models and analytical approaches in relation to monetary policy

Modelling efforts remain at early stages across many countries. The survey has highlighted a desire to be transparent and open about modelling – including assumptions, data and parameters – to help **build capacity and share learnings in the construction process of modelling and analytical frameworks**. Such efforts could draw on work to date across the central bank community to model physical and transition impacts.

The survey also noted that it would be helpful to identify where important gaps in answering the most relevant policy questions exist. Four areas of challenge for central banks in their modelling efforts are apparent:

- (1) integrating climate and macro models;
- (2) capturing uncertainty effects (e.g. preferences and technology);
- (3) exploring linkages across sectors, including spillovers and migration of the factors of production, and;
- (4) physical risk scenarios, in particular improving supply-side modelling such as the role of land, housing and capital.

This list of gaps is by no means exhaustive, and success in filling these gaps will rely on learning from one another as well as from the broader academic and scientific communities engaged on these topics.

Looking ahead, the NGFS will seek to foster close collaboration among central banks to support building modelling capabilities across the membership as well as work towards addressing the four areas of challenge identified.

## 4. Integrating climate considerations in monetary policy operations

The 2021 NGFS report, *Adapting central bank operations to a hotter world*, identified nine options for how central banks could integrate climate-related considerations into their operations through three main frameworks: credit operations, collateral, and asset purchases. While the feasibility of these options depends on central bank mandates, legal environments, and specific national circumstances and characteristics, the survey responses show that central banks have taken action across all three framework areas over recent years:

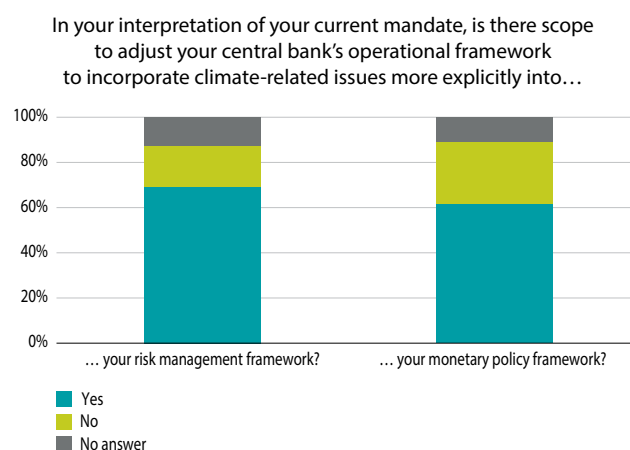
- Adjustments to asset purchase programmes appear to be the most commonly adopted measure with 35% of central bank respondents having taken such measures (of which 79% were central banks from the euro area<sup>5</sup>, plus a handful from other AEs and EMDEs).
- Adjustments to collateral frameworks have also been implemented by almost a third (31%) of central bank respondents (of which 88% were from euro area central banks).
- 5% of central bank respondents (mainly EMDEs) have amended conditions and criteria for credit operations.

These observations are consistent with the findings from the survey that the majority of responding central banks see scope in their mandate to adjust their respective operational frameworks to take into account climate-related issues in their risk management and/or monetary policy frameworks (Chart 5).

More specifically, a slightly larger share of respondents considers that there is more scope to adjust their risk management frameworks, rather than their monetary policy frameworks.

The survey replies also highlight that while several central banks see scope in their mandate to make climate-related adjustments, many are yet to analyse how they might integrate climate considerations into their operations.

Chart 5 **Scope for adjusting central banks' operational frameworks to integrate climate-related issues**



As part of their responses, more than two-thirds of central banks (of which: 68% were AEs; and 54% from euro area central banks) noted potential tensions and trade-offs between monetary policy effectiveness and risk management objectives as inhibiting their ability to integrate climate-related issues into their operational frameworks. For example, significantly increasing collateral haircuts to manage climate risks could inhibit the monetary policy transmission mechanism because it limits the amount of central bank liquidity that banks can draw on. Tensions between risk management and monetary policy effectiveness are not new or unique to climate risks though. The fact that many central banks concerned about potential tensions are among those already taking action suggests that several central banks are navigating these tensions successfully. Central banks may hence want to learn from each other on how to navigate any such tensions, taking into account their specific domestic situation.

<sup>5</sup> Replies by euro area central banks have been counted individually in this survey. However, given their shared monetary policy, when explicitly mentioned, some of the analysis in this section groups all of them together in order to provide a balanced view of the global situation.

## Greening monetary policy operations: progress and obstacles

Overall, two-fifths of central banks take climate change considerations into account in their operational frameworks (of which two-thirds were central banks within the euro area). The motivations varied, but commonly cited reasons included contributing to the transition to a net zero economy, leading by example, managing/mitigating their own balance sheet risks and to align with other regulatory initiatives.

In terms of specific measures, central banks focused on integrating climate change considerations into the eligibility of assets as collateral and for asset purchases. Several central banks, mostly from AEs, developed methodologies to skew asset purchases according to climate-related criteria (*tilting*). Others introduced criteria to accept ESG assets<sup>6</sup> that were previously ineligible (*positive screening*). Other central banks established criteria that exclude assets issued by the most polluting entities (*negative screening*). A handful of other central banks, predominantly in EMDEs, have modified the conditions of credit operations to encourage lending to actors supporting the transition. This can be achieved by adjusting counterparty eligibility to take into account an entity's climate performance and/or the pricing of operations according to a climate-related benchmark which can be applied to the mobilized collateral or to the counterparties' new lending activity.

Finally, some central banks have introduced disclosure requirements for counterparties or issuers so that they can start collecting data on the climate performance of central bank eligible assets and support greater transparency in the broader market. A few central banks have taken the next step and started to disclose emissions data and alignment metrics on their own monetary policy portfolios.

A common theme emerging from those central banks who have taken action to date is the need to ensure that

actions taken remained within the boundaries of their respective mandates. Particular attention has been paid to avoiding impinging on the achievement of other policy goals, and on maintaining market functioning. Additional challenges have included seeking to avoid potential moral hazard and greenwashing issues, while, from a practical perspective, central banks continue to face issues related to the availability and quality of data.

In some jurisdictions, notably in EMDEs but also in some AEs, central banks highlight that the absence of a clear taxonomy and/or a lack of green assets have created obstacles to integrating climate considerations into their monetary policy operations. Finally, some central banks have faced operational difficulties in setting in place climate-related measures, in the absence of suitable policy instruments and/or robust methodologies.

Looking ahead, around two-thirds of central bank respondents – of which more than half were from EMDEs and the remainder largely euro area central banks – have future plans to take climate change considerations into account in their monetary policy operations for the first time, or to take additional steps to account for climate change.

## Facilitating learning from each other

The survey responses highlight that many central banks are taking action to integrate climate-considerations into the design of operational frameworks. While the successful implementation of various types of measures has produced valuable information and real-world experience, several central banks still face a range of challenges and the lessons from early adjustments are still ongoing. Against this background, the NGFS aims to facilitate knowledge sharing on the technical aspects of central banks' experiences and learnings with their own climate-related activities to date as a way to allow other central banks to green their own operations should they wish to do so.

<sup>6</sup> This includes, for example, green or sustainability-linked bonds.

## Conclusion and way forward

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Climate change and the transition to net zero emissions is already affecting our economies.

This means that understanding the macroeconomic impacts and implications for the setting and operation of monetary policy is of increasing importance.

Based on the results of the NGFS membership survey and of the expert analyses summarised in this report, the NGFS encourages central banks to pursue individually and collectively the following aspects in their future work:

**(1) Further their understanding of the macroeconomic implications of climate change and of the net zero transition, especially over the monetary policy horizon, including:**

- (a) the theoretical and quantitative impacts of the physical effects of climate change, especially where these effects are becoming more frequent as well as more severe;
- (b) the impacts of the future path for climate transition policies, especially the likely impact on key variables such as inflation, inflation expectations and output;

- (c) developing model toolkits and approaches that help to address the four areas of challenge currently facing central banks in answering climate-related policy questions as they relate to their monetary policy-making responsibilities. These areas are: how to integrate climate and macro models; how to capture uncertainty effects; exploring linkages across sectors (including spillovers and the factors of production themselves); and physical risk scenarios (improving supply-side modelling).

**(2) Facilitate knowledge sharing around the technical aspects of incorporating climate-related considerations into their monetary policy operations** and related learnings to date, to allow other central banks to learn from these experiences.

This work, in driving forwards our foundational knowledge of the macroeconomic effects of climate change and the transition to net zero, will help to enhance the analysis being done within the NGFS on other issues such as financial stability. It will also help to highlight where we need to improve analytical and data capabilities in order to help inform policy decisions.



## References

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