

Network for Greening the Financial System
Technical document

Adapting central bank operations to a hotter world

Reviewing some options

March 2021



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Joint foreword by Frank Elderson and Dr Sabine Mauderer



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The pandemic and its fallout have fast-forwarded us into a new dimension of central bank support to our economies. Central banks across the globe have shown unprecedented levels of resolve, responding swiftly and flexibly using a wide array of monetary instruments.

At the same time, climate change remains an urgent and fundamental threat to our prosperity and collective well-being. Unlike for the pandemic, however, in the climate crisis we cannot see light at the end of the tunnel. The urgency to act is greater than ever: climate risks no longer lie beyond the horizon, they are already materializing. The time to take action is now.

The NGFS started 2021 with undiminished energy and vigor. Our members are more determined than ever to get active, pressing ahead with concrete proposals on how to better account for climate-related risks in central banking and banking supervision. We strongly believe that now is the time for central banks to seriously consider how the progress made in reflecting climate-related risk in supervisory and macro-prudential methods can be matched by similar steps in monetary policy operations.

The report "Adapting central bank operations to a hotter world" examines the implications of climate change for central banks' operational frameworks and for the implementation of monetary policy in practical terms. Building on a common understanding among NGFS members that climate change has implications for the conduct of monetary policy, this report offers the most comprehensive analysis to date. Practitioners from the central bank community reviewed collateral and counterparty policies, asset purchases and credit operations with a view to offering a menu of options for climate-related adjustments in more concrete terms.

This report does not prescribe a particular course of action. Regardless of their specific roles and mandates, central banks ought to be aware of climate risks that could threaten the integrity of their balance sheets. However, each central bank needs to decide for itself the best way to reflect climate risks in its operational framework. We are sure that this report will offer invaluable guidance for central banks in making these strategic choices with regard to their monetary policy operations.

Of course, this is only the beginning. More work is needed to overcome obstacles and to fully integrate climate-related considerations into monetary policy. These issues will rank high among NGFS priorities going forward.

Central banks clearly need to play their part in the joint global efforts to curb climate change as an urgent and universal challenge. While we cannot take on the tasks of governments, we also cannot be mere bystanders in the transition to a net zero economy. It is our responsibility to take on the challenge we are facing as publicly accountable institutions, serving our societies.

We are grateful to all NGFS members and observers for contributing to our common cause in a truly challenging environment. Our network is thriving thanks to your determination and ideas and we urge you to stay committed. Our special thanks go to the lead authors of this report and its contributors, as well as the NGFS secretariat. Their tireless efforts have made it possible for us to mark this important milestone for the NGFS.

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Executive summary

The context calls for concrete action

Under all possible scenarios, climate-related risks will have consequences for the economic outlook, for the financial system in which central banks operate and, thus, for the conduct of monetary policy. The timing and severity of these consequences depend on how swift and effective transition policies are.

Moreover, climate change poses new financial risks to central banks' monetary policy operations. Climate-related financial risks could impact directly on both central bank counterparties and the financial assets used in monetary policy operations (as collateral for credit operations or for outright purchases).

As a result, climate-related shocks could generate financial losses for central bank balance sheets and, in extreme cases, they could affect the smooth implementation of monetary policy by exposing various monetary policy transmission channels to the impacts of physical and transition risks.

Central banks can adapt their monetary policy operational frameworks to reflect climate-related risks

Governments have a much broader and more effective range of tools and policies available to prevent and mitigate climate-related risks than central banks, and they are the actors responsible for designing and conducting national and international climate policies.

However, contingent on their mandate, central banks have a responsibility to review their operational frameworks to ensure they remain resilient to emerging climate-related risks and to safeguard the continued smooth conduct of monetary policy, i.e. to consider the effect of climate-related risks on their operations as well as the effects of their actions on exposures of other entities, including the financial sector, to climate-related risks.

There is a broad consensus among members of the Network for Greening the Financial System (NGFS) that, at the very least, central banks should carefully assess, and where

appropriate adopt, additional risk management measures to protect their balance sheets against the financial risks brought about by climate change. However – and reflecting the diversity of existing central bank operational frameworks – there is as of yet no consensus among central banks as to what climate-related adjustments would be optimal. Identifying the relevant measures and assessing the adequate level of protection against climate-related financial risks, and the quantification thereof, is a challenge for central banks at the current juncture.

Where it falls within their policy remit, central banks could also consider going beyond the adjustment of their operational frameworks solely from a risk management perspective by seeking to ensure that their monetary policy operations do not undermine the transition to a low-carbon economy and/or by exploring ways in which they can actively support that transition.

In practice, the frontier between these alternative approaches (mitigating balance sheet risk on the one hand, and actively supporting transition on the other) is blurred and may depend on the actual calibration of operational measures as well as the central bank's mandate.

According to current scientific evidence, taking no action is not viewed as a sustainable option given the systemic impacts of climate change on the real economy, on financial risk, on market prices and thus on the conduct of monetary policy and on monetary policy frameworks. At the same time, central banks need to be mindful about the potential risk involved in considering adjustments based on what is still a limited body of information, which may have an impact on their credibility.

The menu of options available to central banks to factor climate-related risks into their operational framework is potentially large

Adjustments could be considered across the main operational functions that central banks carry out for the purposes of implementing monetary policy. This report analyses possible changes to three of the most important policy fields: credit operations, collateral policies, and asset purchases.

The review concentrates on potential measures on the asset side of a central bank's balance sheet. Hence, the stylised options listed in Table 1 all pertain to liquidity-providing instruments.

Based on the available literature and expert analyses, the review by the NGFS group of experts focuses on nine stylised options across these three main policy fields (Table 1). They were chosen because they are relevant to multiple

central banks and relate to existing tools. Some options represent a greater departure from standard central bank operational policies than others.

Depending on their mandate, legal environment and individual assessment, certain central banks may not find some of the stylised options to be feasible. The review therefore contains neither recommendations, nor indications of members' preferences.

Table 1. **Selected stylised options for adjusting operational frameworks to climate-related risks**

Credit operations ^a	
(1) Adjust pricing to reflect counterparties' climate-related lending	Make the interest rate for central bank lending facilities conditional on the extent to which a counterparty's lending (relative to a relevant benchmark) is contributing to climate change mitigation and/or the extent to which they are decarbonising their business model.
(2) Adjust pricing to reflect the composition of pledged collateral	Charge a lower (or higher) interest rate to counterparties that pledge a higher proportion of low-carbon (or carbon-intensive) assets as collateral or set up a credit facility (potentially at concessional rates) accessible only against low-carbon assets.
(3) Adjust counterparties' eligibility	Make access to (some) lending facilities conditional on a counterparty's disclosure of climate-related information or on its carbon-intensive/low-carbon/green investments.
Collateral ^b	
(4) Adjust haircuts ^c	Adjust haircuts to better account for climate-related risks. Haircuts could also be calibrated such that they go beyond what might be required from a purely risk mitigation perspective in order to incentivise the market for sustainable assets.
(5) Negative screening	Exclude otherwise eligible collateral assets, based on their issuer-level climate-related risk profile for debt securities or on the analysis of the carbon performance of underlying assets for pledged pools of loans or securitised products. This could be done in different ways, including adjusting eligibility requirements, tightening risk tolerance, introducing tighter or specific mobilisation rules, etc.
(6) Positive screening	Accept sustainable collateral so as to incentivise banks to lend or capital markets to fund projects and assets that support environmentally-friendly activities (e.g. green bonds or sustainability linked assets). This could be done in different ways, including adjusting eligibility requirements, increasing risk tolerance on a limited scale, relaxing some mobilisation rules, etc.
(7) Align collateral pools with a climate-related objective	Require counterparties to pledge collateral such that it complies with a climate-related metric at an aggregate pool level.
Asset purchases ^d	
(8) Tilt purchases	Skew asset purchases according to climate-related risks and/or criteria applied at the issuer or asset level.
(9) Negative screening	Exclude some assets or issuers from purchases if they fail to meet climate-related criteria.

a Credit operations are widely used to provide aggregate liquidity and usually take the form of collateralised lending.

b Collateral policy defines the range of assets that can be pledged to secure central bank credit operations, as well as the risk control measures that apply to them.

c Annex 1 expands upon the different approaches for haircuts and valuation adjustments.

d Central banks may buy a variety of assets from both public and private sectors, typically in an effort to exert greater influence on longer-term interest rate levels and spreads while improving market liquidity.

Four criteria can help review the menu of options available to central banks

Assessing different climate-related adjustments to monetary policy operations is difficult because of the heterogeneity of central bank operational frameworks.

Regardless of these differences, the potential adjustments to central bank operations can be assessed against four general principles (see Table 2). These are: (1) Consequences for monetary policy effectiveness; (2) Contributions to mitigating climate change; (3) Effectiveness as risk protection measures; and (4) Operational feasibility. Depending on their mandate and on the course of action chosen, central banks may assign different weights to these four principles.

Consequences for monetary policy effectiveness.

Assessing the implications for the effectiveness of monetary policy operations (including in terms of lending or purchasing capacity by the central bank, potential distortions, stigma, etc.) of any of the options is challenging since they very much depend on their exact design as well as the central bank's specific circumstances. Still, options which materially reduce available monetary policy space, or which can jeopardise the efficacy of monetary policy, are unlikely to be considered desirable, in particular if their design and calibration cannot be used to minimise any unintended consequences. While further jurisdiction-specific work is needed, a few preliminary points can be made. Some options run the risk of curtailing, more or less significantly, central bank operations and the policy space. These options include (i) negative screening that would (a) exclude a significant number of counterparties from credit operations based on their carbon footprint or carbon disclosure; (b) exclude assets potentially representing a significant share of the purchasable universe or of eligible collateral; and (ii) adjusting the pricing of credit operations to the composition of collateral. For other options, the implications for the effectiveness of monetary policy may be less relevant or even negligible, though this ultimate impact would need to be assessed in light of each central bank's circumstances. Another key point of vigilance concerns the potential unintended consequences that some options may have for financial stability.

Contributions to mitigating climate change. A few options may be more impactful from a climate change

mitigation perspective than others. These include measures aimed at (i) adjusting the pricing of targeted credit operations to a lending benchmark; (ii) positively screening collateral; (iii) aligning collateral pools; and (iv) tilting asset purchases. They typically consist of modifying existing tools without fully overhauling their design (e.g. leveraging pricing schemes for targeted credit operations) in order to encourage lenders to originate or invest more in low-carbon and transition assets. It is unlikely that they would materially curtail operations and policy space. Seen from this perspective, they would be consistent with the smooth implementation of monetary policy but still technically challenging to operationalise. At the same time, potential implications for asset pricing and market functioning have to be carefully assessed.

Effectiveness as risk protection measures. Many of the options reviewed would probably better shield central bank balance sheets against increasing financial risks, most effectively through those options aimed at directly reducing risk exposure (to issuers or counterparties). Accordingly, the following options are viewed as being probably risk-protective: (i) negatively screening counterparties to credit operations based on their carbon footprint or carbon disclosure; (ii) adjusting haircuts and valuations; (iii) negatively screening collateral; (iv) aligning collateral pools; (v) tilting asset purchases; and (vi) negatively screening purchasable assets. However, for some of them (e.g. negative screening options), this potentially positive impact could be diluted, or in some cases outweighed, if the reduction in the eligible universe were associated with higher financial risk concentrations, or greater credit risk unrelated to climate change. A priori and contingent on each central bank's mandate, options designed from a financial risk perspective may be less exposed to legal risks and challenges than others designed to support climate-related objectives, especially if the latter are seen as subsidising some economic sectors, issuers or assets. Yet for many options, the actual impact from a risk protection perspective is difficult to assess without a detailed specification.

Operational feasibility. All options entail significant changes to central bank operational frameworks. The least challenging options to operationalise are the least sophisticated ones (e.g. the simplest form of exclusion measures) in terms of addressing climate-related risks. Conversely, the options that are less likely

to entail adverse consequences for monetary policy effectiveness are typically associated with somewhat higher operational complexity. This is the case for (i) adjusting the pricing of targeted credit operations to a lending benchmark; (ii) adjusting haircuts and

valuations; (iii) aligning collateral pools; and (iv) tilting asset purchases. Whether any additional complexity would be warranted to achieve a reduction in financial risk or improved climate outcomes would need to be assessed on a case-by-case basis.

Table 2. Simplified comparative assessment of the selected generic options under review

	CREDIT OPERATIONS			COLLATERAL			ASSET PURCHASES	
	(1) ADJUSTING PRICING TO LENDING BENCHMARK	(2) ADJUSTING PRICING TO COLLATERAL	(3) ADJUSTING COUNTERPARTIES' ELIGIBILITY	(4) HAIRCUT ADJUSTMENT	(5) NEGATIVE SCREENING	(6) POSITIVE SCREENING	(7) ALIGNING COLLATERAL POOLS	(8) TILTING
CONSEQUENCES FOR MONETARY POLICY EFFECTIVENESS	Minimal	Negative	Strongly Negative	Minimal	Negative	Positive	Minimal	Negative
CONTRIBUTION TO MITIGATING CLIMATE CHANGE	Positive	Positive	Positive	Positive	Positive	Strongly Positive	Positive	Positive
EFFECTIVENESS AS RISK PROTECTION MEASURE	Minimal	Minimal	Positive	Positive	Positive	Negative	Positive	Positive
OPERATIONAL FEASIBILITY	Negative	Negative	Minimal	Negative	Minimal	Minimal	Negative	Minimal

POTENTIAL IMPACT : ■ STRONGLY POSITIVE ■ MINIMAL ■ STRONGLY NEGATIVE
■ POSITIVE ■ NEGATIVE

The assessment is based on qualitative expert judgement, and more formal quantitative analysis may be needed. It aims to guide the reader through the report and should not be interpreted as recommending any measure. Colour-coding is used to avoid any “netting” across criteria. The table uses a limited number of colours for reasons of simplicity. More nuanced analyses of options are provided in Annex 1.

All in all, adjusting central bank operational frameworks to more adequately reflect climate-related considerations is feasible. Yet the climate-related adjustments of central bank operations have to overcome a range of practical and analytical challenges, including data gaps and uncertainties with regard to risk quantification. There is a priori no “one size fits all” option that clearly maximises the benefits across all four principles listed above.

Enhanced disclosure of climate-relevant data is instrumental to support central banks’ actions

Enhancing the disclosure of climate-relevant data is a policy issue that cuts across many of the potential options, while disclosure requirements may be designed by central banks depending on their respective responsibility within their jurisdiction. Increasing the quantity and quality of climate-relevant information is a critical step in enabling central banks and market participants to better understand their exposures to climate-related risks.

In some cases, the increased availability of climate-related information may be a prerequisite for adjusting certain operational frameworks, especially where operational changes may pose legal and reputational risks. However, some climate-related adjustments to operational frameworks can be developed in parallel to initiatives fostering comprehensive data disclosure. When balancing the need for robust and comprehensive data against the opportunity cost of inaction, central banks should be cognisant of the risk that acting early with imperfect information could be less costly than acting only once stronger data standards have emerged.

Introducing disclosure requirements in monetary policy operations could help foster harmonised, transparent, reliable and comparable data. To reduce the operational burden of disclosure requirements and cater for issues associated with comparability and transparency, central banks could make use of existing reporting frameworks and minimise deviations from such frameworks or forthcoming regulations in their respective jurisdictions.

Central banks may wish to disclose climate-related information on their own policy operations and financial activities. This could be motivated by considerations about transparency and accountability to the public about the climate-related risks they take as part of their operations. It can also serve to signal a central bank's commitment to enhancing the availability of climate-related risk information and set a positive example to assist market participants in developing their own disclosure frameworks.

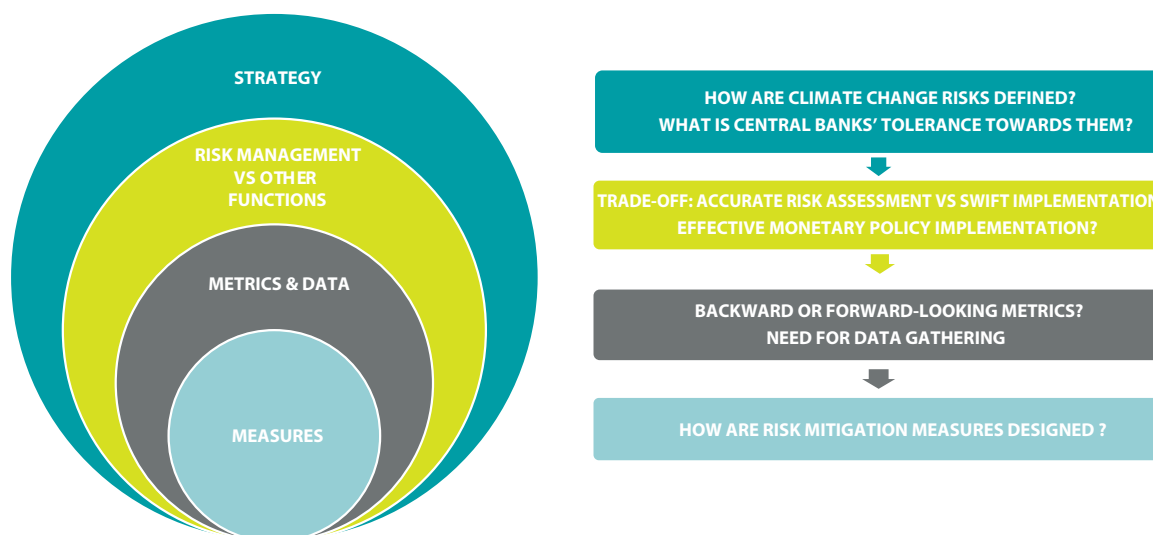
To take action, central banks must decide on some strategic issues

Central banks can formulate a clear strategic view on their tolerance of climate-related risks and decide how forward-looking they wish their frameworks to be.

Central banks need to form a clear opinion surrounding the appropriateness of various climate-related metrics in order to adjust their operational frameworks. At the current juncture, in the absence of reliable and commonly agreed ways of putting a price tag on climate-related risks, central banks wishing to act may have no choice but to consider using non-financial climate-related metrics as a pragmatic starting point.

Central banks should develop policies to monitor and manage issues surrounding data quality and availability. The limited availability and accuracy of relevant data is currently constraining virtually all climate-related risk metrics.

Figure 1. Strategic choices for adapting monetary policy operational frameworks to climate-related risks



Against this backdrop, central banks face some trade-offs when dealing with climate-related risks. On the one hand, central banks have to operate within their specific legal framework, and as publicly accountable institutions, they have to provide rigorous evidence in support of all actions they take – this may lead them to taking a cautious approach to adopting policies for new risk drivers such as climate change. On the other hand, central bank balance sheets might already be exposed to climate-related risks,

which is why early action to mitigate them would be called for in the interests of the prudent risk management of public funds. Owing to the heightened uncertainty surrounding the exact timing and magnitude of climate-related risks' materialisation, the optimal policy for many central banks is likely to be to adopt gradual, predictable, precautionary risk protection measures. This approach should be in line with, and conducive to, emerging best practices.

1. Introduction

This report forms part of the work of the Network for Greening the Financial System’s (NGFS) group of experts that investigates the possible effects of climate change on the conduct of monetary policy.

The first report, “Climate change and monetary policy – initial takeaways” (NGFS, 2020a), explored how climate change affects key macroeconomic variables and, as a consequence, the conduct of monetary policy and its transmission channels. Central banks were recommended to consider the possible effects of climate change on the economy and thus on the conduct of monetary policy. To do so, they may need to reinforce their analytical, forecasting and modelling toolkit so as to better capture and understand the economic and financial impacts of climate change. Moreover, they may evaluate whether and how they might need to adapt their monetary policy operational framework to climate change.

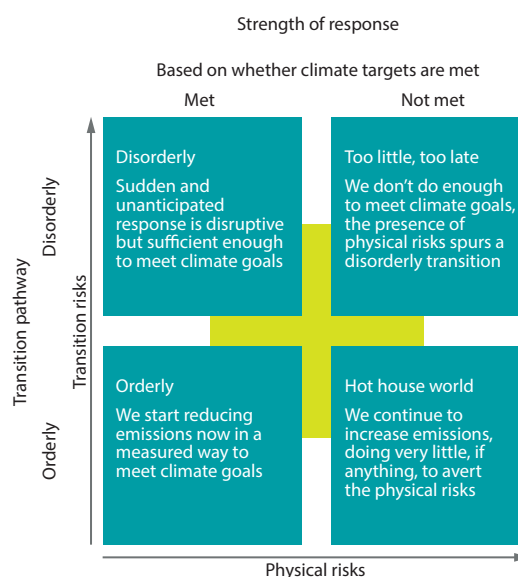
This second report focuses on the operational implications of climate change for central banks, with a particular focus on the implementation of monetary policy. It is motivated by several considerations, which are related to one another and on which further work is needed.

First, in all possible scenarios, climate change will impact on economic agents and their behaviour.

An orderly transition towards a 1.5°C-2°C of average global temperature rise requires substantial mitigation measures to reduce physical risk, which will require public, economic and financial agents to invest and adapt. By contrast, a lack of mitigation and adaptation policies would lead to a “hot house world” scenario which is expected to result in rapidly soaring costs stemming from spiralling physical risk impacts (see Figure 2). Alternatively, there could be “disorderly” transition scenarios – perhaps related to the effectiveness, timing, heterogeneity and acceptance of mitigation policies – in which a range of physical risks (limited or high) could unfold. Under all scenarios, there could be swift

shifts in sentiment amongst financial market participants, affecting asset valuations and increasing volatility in risk perception. Financial markets could eventually witness a flight into assets deemed safest from the standpoint of climate change, and out of assets considered least safe from that vantage point. The bottom line is that, in all scenarios, the economic and financial ecosystem in which central banks conduct their monetary policy will very likely change, which has implications for the design of monetary policy operational frameworks.

Figure 2. NGFS climate scenarios framework



Source: NGFS (2019a)

Second, monetary policy transmission channels¹ are likely to become increasingly exposed to climate-related risks – that is, both physical and transition risks. The credit channel could experience the greatest effects, which may be a source of concern in countries where it is the predominant transmission channel. More generally, as the NGFS has already pointed out,² climate change has the potential to affect financial intermediaries’ balance sheet capacity,³ which could weigh on their ability

1 These comprise the interest rate channel, the expectations channel, the credit channel (via bank lending and market-based finance) and the risk-taking channel.

2 See NGFS (2019b).

3 These include credit institutions, insurance companies, broker-dealers and different types of investment funds (pension, money market, mutual funds). In this introduction we simply refer to “banks”.

to transmit monetary policy effectively to the broader economy. Climate change can also affect monetary policy transmission through the expectations channel. Though climate-related risks might materialize later, economic agents may anticipate them and adapt their behaviour accordingly. This, in turn, could affect monetary policy and its transmission channels. On the other hand, the extent to which these potential effects could affect the ability of monetary policymakers to achieve their objectives is not yet known, and there is a consensus that further work by central banks is needed on this front. Therefore, central banks are each expected to carefully assess whether those risks have material implications for the implementation of monetary policy.

Third, because it will affect the net worth of economic agents, climate change could reduce the value of the assets available to banks to participate in central bank monetary policy operations. The balance sheets of firms and households may be hit – directly and indirectly – by physical and transition risks. Both climate change and new transition policies may affect the net present value and probability of default of assets pledged to central banks, and thus impact collateral values. The quantitative importance of such effects still needs to be assessed. Lastly, more frequent and more damaging extreme weather events and changes to the regulatory environment for greenhouse gas (GHG)-emitting sectors may affect asset prices in the financial sector and the real economy alike.

The extent to which central banks may find it appropriate or advantageous to adjust their existing operational frameworks still needs to be assessed. From a broad perspective, in recent instances where central banks have intervened to reinforce an impaired transmission of monetary policy (e.g. during the Great Financial Crisis, 2007-09), their actions aimed to address concrete and manifest financial market malfunctioning. Climate change, by contrast, while already manifest, represents a risk that will likely crystallise in such a way that could disrupt the monetary policy transmission channel in the future. Central banks need to assess, measure and, where appropriate, manage the risks from climate change just as they would for any other type of financial risk, while safeguarding the continued effective transmission

and smooth implementation of monetary policy today. In this endeavour, they need to assess whether, and take into account that, a failure to make orderly and timely adjustments to their monetary policy framework may endanger their ability to meet their primary objectives of monetary and financial stability in the future. Nevertheless, while central bank policies can potentially complement actions by governments to facilitate, manage and bring forward climate transition, they cannot be a substitute for climate policies.

To shed light on these issues, this report builds on three inputs. First, it draws on a survey of NGFS member central banks⁴ that aimed to identify whether central banks across the world are currently thinking of adjusting their operational frameworks, and how, in order to take account of climate-related risks. While this survey confirmed that there is a growing shared awareness of the magnitude of the climate challenge and the importance for central banks of managing climate-related risks contingent on their mandate, it also revealed that concrete action by central banks has been limited. This likely reflects the systemic nature of the challenges that climate change poses and the complexity and novelty of measuring and modelling those longer-term risks dynamically. Second, the report leverages on an extensive review of studies and proposals by researchers, academics and other non-central bankers about the operational implications of climate change for monetary policy (see Annex 4). That review shows the wide range of monetary policy tools currently used by central banks across the world, suggesting that adjustments to those policy tools to address climate-related risks will need to be tailored to each institution's own circumstances. Third, the report analyses case studies of climate-related measures implemented by central banks (see boxes in Annex 1). These illustrate the variety of options available to central banks and objectives pursued.

The report should be read as a first attempt by central banks to look jointly into the potential operational implications of climate change for monetary policy implementation. It does not contain any specific recommendations. Rather, it seeks to identify the strategic choices, general concepts and potential adjustments to operational frameworks that central banks may wish to

4 See NGFS (2020b).

consider, as well as the possible constraints on change which need to be taken into account. Further economic research and work by the central banking community is needed for robust conclusions to emerge on several points raised in this report. Besides, each central bank is uniquely placed to assess whether and how climate-related risks may affect the design of its own monetary policy tools.

The focus of the report is on climate-related financial risks. These are referred to interchangeably as either climate-related financial risks or as climate-related risks.

This report is organised as follows. Chapter 2 takes stock of monetary policy operational frameworks to identify the key constraints central banks face when considering adapting them to climate-related risks. Chapter 3 presents four general principles that could be used to analyse and compare potential options for these adjustments. Chapter 4 reviews a selected set of potential adjustments to operational frameworks, applying the general principles. Chapter 5 discusses the role disclosure can play in adjusting monetary policy operational frameworks. Chapter 6 identifies the strategic choices a central bank faces when considering climate-proofing its monetary policy operational framework.

2. The state of play

2.1. Climate change brings new financial risks for central banks

Climate change is a source of financial risk. Climate-related financial risks arise through two main channels. Transition risks arise from the significant structural changes required for economies to adjust towards a low-carbon economy (disruptive innovations, policy changes⁵ including carbon pricing policies, shifts in consumer preferences⁶). These transition risks can lead to assets becoming “stranded”, i.e. losing value as a result of unanticipated changes in expected cash flows. Uncertainty surrounding climate change policies and their pace is one driver of transition risk.⁷ Physical risks arise from the increasing severity and frequency of extreme climate and weather-related events (e.g. floods and hurricanes), and chronic shifts in weather patterns (e.g. temperature increases, rising sea levels). The materialisation of either risk type can cause heavy financial losses and impair asset values through unanticipated changes in their expected cash flows,⁸ impacting the creditworthiness of particular issuers, and giving rise to systemic risk (for more details, see NGFS 2019b, NGFS 2020a). Climate change being an externality, it may be the case that the associated financial risks are not sufficiently reflected in prices. Even increased climate-related disclosure may not result in market prices reflecting the entire social cost of climate change. The suggestion instead is to determine this collectively, e.g. through a political process and the introduction of climate policies.⁹

Climate-related financial risks could have medium to long-term implications for the economic outlook and financial system. Climate change could materially affect monetary conditions. For instance, abrupt asset price corrections triggered by climate-related risks may make it

harder for banks or other financial intermediaries to obtain liquidity in interbank and other short-term funding markets because of higher perceived counterparty risk or reduced collateral availability. Falling asset prices also reduce the value of the collateral available to firms and households to support credit demand. In the presence of falling asset values, banks may reduce their credit supply in order to maintain regulatory capital ratios.¹⁰ Such shocks could alter monetary policy transmission channels (see Figure 3), and, potentially, the ability of central banks to safeguard financial stability.

Climate-related financial risks may damage market confidence, output and financial stability, and thus affect both the counterparties and financial assets that are used in monetary policy operations. These risks could impact monetary policy through their effect on the financial soundness of central banks’ counterparties, and on the value of assets pledged as collateral or held outright. If the market values of eligible assets were to fall excessively, it could reduce the amount of liquidity available to central bank counterparties. A counterparty’s access to liquidity could also be curtailed if its exposure to climate-related risk jeopardises its financial position to a point where it ceases to meet its central bank’s financial soundness requirements. Lastly, adverse climate-related price shocks to assets that are purchased outright may need to be taken into account when setting quantitative easing policies and central bank targets.

As sources of financial risk, climate-related shocks can generate losses for central banks. While a central bank’s objective is not to generate profits but to fulfil a broader mandate, typically related to broader social welfare, financial losses can nevertheless pose risks to its reputation, credibility and financial independence and may require recapitalisation measures.

5 McGlade and Ekins (2015) estimate that one-third of global oil reserves and half of gas reserves should remain unextracted in order to limit global warming to 2°C. Stricter national regulations to limit the extraction of petroleum will be necessary in order for countries to achieve their nationally determined contributions, as pledged under the Paris Agreement.

6 See UN PRI (2019).

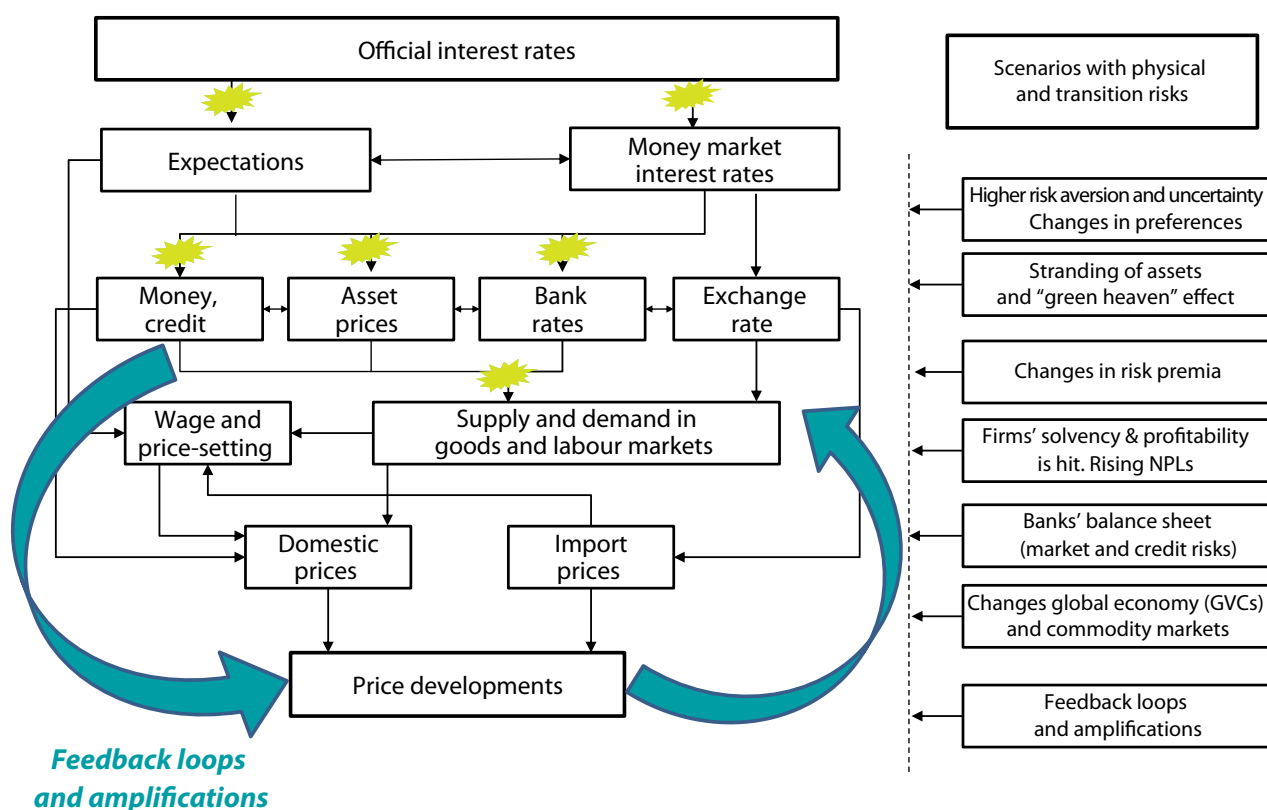
7 For example, when policies are introduced gradually, assets may experience a loss in value over time with manageable adjustment costs. For this to happen, policies must be credible and investors need to understand how to account for them. See Sen, S. and M. T. von Schickfus (2020).

8 See IPCC (2018).

9 For more details see Krogstrup and Oman (2019).

10 See Batten, S., R. Sowerbutts, and M. Tanaka (2016).

Figure 3. **Monetary policy transmission under climate change strains**



2.2. Adapting traditional central bank models to climate change?

Central banks have not yet reached a consensus as to whether and how their operational frameworks should incorporate the effects of climate change.

Modern central banking rests on certain commonly accepted principles. One of them is that, typically, a central bank does not seek to target individual firms, households, regions or economic sectors. Another is that, to limit inflation risks, governments should not have automatic access to central bank (base) money. These two principles, though not universally accepted, imply that a central bank should refrain from using its powers to carry out tasks that do not fall within its remit or tasks that might more properly be the responsibility of governments.¹¹

As far as climate-related risks are concerned, governments have the principal responsibility for

setting the policy response to climate change and have a much broader range of tools and policies on hand to prevent and mitigate it than central banks do. Such tools may include incentives for agents to shift to low-carbon activities, perhaps by way of increasing carbon prices via taxation or the issuance of carbon certificates, supporting research on and investment in low-emission technologies or even prohibiting certain activities altogether (Lagarde and Gaspar 2019, Arezki and Obstfeld 2015, Farid et al. 2016). If central banks introduce, for example, measures focused on leading and shaping the financial sector’s response to climate change, they can complement government-led action.

Whether and to what extent central banks should modify their behaviour and approaches in support of governments’ objectives on climate-related issues depends, inter alia, on their mandate and on social norms, which differ across regions. Societal conventions help shape institutional frameworks such as central

11 See Honohan, P. (2019). For more details, see Tucker, P. (2018).

bank mandates and therefore influence their room for manoeuvre in supporting government policies. Thus far, central banks (or relevant policy committees) with mandates that explicitly include climate-related objectives are an exception. Nevertheless, in the NGFS survey mentioned in the introductory chapter, many central banks indicated that there is scope in their existing mandates to adjust their policy frameworks should they decide to cater more for climate-related challenges.¹²

Expectations about central bank actions evolve over time. As they deployed new instruments to address recent crises (e.g. the 2007-09 crisis and the fallout of the COVID-19 pandemic), central banks faced increased scrutiny about their actions and how they manage the side effects without compromising on their primary objective.¹³ The at times controversial debate surrounding the role that market neutrality should play in the practical implementation of monetary policy is a case in point.

Faced with climate-related risks, central banks must ensure that their operational frameworks remain efficient for the smooth conduct of monetary policy within their mandates, while mitigating the risk that their actions conflict with the broader climate policies needed to transition to a low-carbon economy. Central banks should be mindful that their actions can undermine the transition to a low-carbon economy and consider the double-materiality perspective of their actions, which consists of taking into account the effect of climate change on them, as well as the effects of these actions on climate change itself.

2.3. Potential courses of action

There is a consensus among NGFS members that, at the very least, central banks should carefully assess and, where appropriate adopt, additional risk management measures to protect their own balance sheets against the financial risks brought about by climate change. As mentioned above, central banks are directly exposed

to climate-related financial risks through their operational frameworks, and they may incur financial losses if they fail to protect themselves against those risks. Currently, central banks' operational frameworks typically account for liquidity, market and credit risks through a range of risk management rules and techniques, which include financial soundness checks, minimum rating requirements and other eligibility criteria for collateral, collateral haircuts, valuation markdowns, due diligence of asset purchases, and concentration limits. Further work is needed to determine whether current measures are sufficient or suitable enough to protect central banks against climate-related financial risks.

Assessing the appropriate level of protection against climate-related financial risks is a challenge for central banks. These risks are intrinsically difficult to measure with precision, notably due to the radical uncertainty that characterises climate risks (tipping points, non-linearities, regime shifts, etc.), not to mention practical issues such as data and methodological gaps. As a result, it cannot be taken for granted that existing risk control measures by central banks provide adequate protection against climate-related risks. Central banks need to use appropriate risk management tools to identify, measure, and, if necessary address, these risks.

Aside from risk management-driven initiatives, another reason for central banks to consider action relates to the potential for adverse consequences that climate-related shocks could have for the effectiveness of monetary policy over time. While their materiality is under investigation at many central banks, it is widely recognised that climate-related shocks will adversely and increasingly impact macroeconomic and price stability.¹⁴ These negative impacts may vary depending on the ability of monetary policymakers to respond and any measures that are already in place. The recent survey among NGFS members highlighted that some central banks consider they are already experiencing some of these effects on the transmission channels of monetary policy, mainly following natural disasters.

¹² See NGFS (2020b).

¹³ See Honohan, P. (2019).

¹⁴ See NGFS (2020a).

Central banks may also consider supporting the transition to a low-carbon economy using monetary policy tools, where they have a clear policy remit to do so. The seriousness of the global climate challenge suggests that some combination of protective and climate mitigation approaches may be required, insofar as they can be balanced with central banks' existing institutional objectives. To the extent that the design of monetary policy instruments may conflict with incentives for a smooth transition to a low-carbon economy, central banks will have to assess whether they can adjust their toolkits without compromising on the efficiency of monetary policy. However, the main driver for the transition to a low-carbon economy should remain the action taken and transition strategy laid out by governments.

Overall, the distinction between “protective” and “proactive” approaches to climate-related risks is blurred from an operational viewpoint. Moreover, central banks need to clarify their climate-related objectives before designing measures. Some options would allow central banks to both protect themselves against climate-related risks and take action to mitigate their effects. Some climate-related risk protection measures can have positive side effects for the transition to a low-carbon economy. Conversely, some proactive measures may give the central bank's balance sheet greater protection over the medium term. However, protective and proactive measures can sometimes lead to conflicting results. Some proactive measures may not protect the central bank balance sheet,

and some protective measures may not protect the climate. Even if the same tools can usually be used to implement both proactive and protective policies, the scope/calibration of the policies might be different if used for risk protection or to promote the transition.

Some considerations may induce central banks to refrain from adjusting their operational frameworks. In the short term, these relate notably to operational difficulties and the risk of miscalibration or of unintended negative consequences for monetary policy implementation and for the central bank's credibility. Climate-related risk measurement remains a nascent field, and central banks do not know more than financial markets about how to measure or price climate-related financial risks. Depending on the nature of the adjustment, there may also be constraints on the authority of the central bank.

Taking no action is not viewed as a sustainable option over time, not least because climate change brings new financial risks for the central bank. Making adjustments prematurely, without suitable knowledge, data, or legal clarification regarding the central bank's mandate may undermine its credibility.¹⁵ That said, the scientific consensus is that the damage associated with unmitigated climate change will be high and increasing over time, and that the risk of catastrophic tail events is by no means negligible. Such significant economic damage could force central banks to adjust their operations in a precipitous way, hence the need for central banks to at least consider the issue now.

¹⁵ Indeed, some central banks may decide not to take immediate action, depending on their exposure to climate-related risks and/or due to constraints such as their mandate and the lack of sufficient research.

3. Principles for assessing potential climate-related adjustments to monetary policy operational frameworks

Assessing potential climate-related adjustments to monetary policy operations, in general, is challenging because of the heterogeneity of central bank operational frameworks. Most monetary policymakers focus on price stability as a primary objective,¹⁶ which typically means low and stable inflation and/or exchange rate stability. However, even monetary policymakers with similar primary objectives may implement their policies differently. Indeed, the operational frameworks of central banks can vary significantly in terms of their operational targets, the liquidity environment in which they operate, and the choice of preferred instruments.

Regardless of these differences, potential adjustments can be assessed against four general principles. These are: (1) Consequences for monetary policy effectiveness; (2) Contributions to mitigating climate change; (3) Effectiveness as risk protection measures; and (4) Operational feasibility.

3.1. Consequences for monetary policy effectiveness

While climate-related risk adjustments may be helpful in terms of risk identification and mitigation, some may have negative consequences for the conduct and effectiveness of monetary policy operations, which would likely count against their adoption. Monetary policy operations are often designed to minimise intervention in financial markets while maximising the pass-through of policy measures and treating economic agents equally and fairly. Climate-related adjustments to the operational framework which result in constraints on a central bank's policy space, or which strongly disincentivise participation in monetary policy operations or reduce the effective transmission of monetary policy are unlikely to be considered desirable. Such effects may also arise if these constraints have not yet manifested but agents are expecting them. This assessment should evaluate the extent to which any such measures conflict with monetary policy transition mechanisms.

3.2. Contributions to mitigating climate change

Climate-related adjustments to monetary policy operational frameworks should be assessed in terms of their relevance and ability to mitigate climate-related risks and/or support the transition to a low-carbon economy. Adjustments should be assessed in terms of whether they will conflict with, delay, support, or be conducive to a smooth transition. In practice, assessing the effectiveness of any measure on mitigating the impact of climate change should rest on the principle of proportionality that many central banks follow, according to which any potential side effect of the measures should be weighed against its benefits.

3.3. Effectiveness as risk protection measures

Central bank risk management frameworks typically aim to ensure that monetary policy objectives can be achieved with the lowest financial risk possible. Changes to these frameworks to take climate-related risks into account should, in principle, improve the identification, measurement and mitigation of financial risks. This assessment should consider whether climate-related adjustments would improve or impair a central bank's financial risk management. Central banks should also be mindful of mitigating excessive asset price adjustments stemming from their risk management framework.

3.4. Operational feasibility

Climate-related adjustments to central bank operational frameworks require (i) access to sufficiently robust and broad-based climate-related risk data; (ii) expertise in climate-related financial risk management; and (iii) sound methodologies and models to embed climate-related measures into operational frameworks.

¹⁶ See NGFS (2020b).

Depending on the course of action chosen, central banks may also assign different weights to these principles.

For instance, a central bank that is concerned about climate-related risks predominantly from a financial risk management perspective is more likely to assign a higher weight to a measure's

effectiveness for risk protection than to its ability to support the transition to a low-carbon economy. Organisational factors may also influence the relative importance of the principles. Central banks with limited resources may give comparatively more importance to operational feasibility.

Box 1

What is the carbon performance of monetary policy operations?

Central banks, like other institutions, face increasing demands for greater transparency on their carbon performance. An increasing number of businesses and financial institutions are assessing their carbon performance, either voluntarily or to meet requirements set by law. Given the prominent role central banks play in the financial system, the impact of monetary policy on climate change has been subject to increased scrutiny in some jurisdictions.

Assessing the carbon performance of monetary policy operational frameworks is particularly relevant for two core monetary policy operations: asset purchases and collateral policies. As of today, few central banks have assessed and published their carbon performance. The Bank of England published its first climate-related financial disclosure in 2020, following Task-force on Climate-related Financial Disclosures (TCFD) recommendations. The Riksbank has announced its intention to report on the carbon footprint linked to its corporate bond purchase portfolio in the first half of 2021.

A consistent and comprehensive assessment of the CO₂e footprint of monetary policy operations is challenging. This is due to data coverage problems as well as methodological issues that are not specific to central banks, but are likely to be of a larger order of magnitude given the scope, scale and specificities of their operations.

- At the current juncture, assessing the CO₂e performance of some asset classes that are relevant for monetary policy is difficult. For instance, assessing covered bonds

and securitisation products, which are accepted by some central banks as collateral and/or held in policy portfolios, would likely require a look-through approach on their underlying assets. However, detailed data on the carbon performance of underlying bank loans are typically unavailable or only to a limited extent. Initiatives are ongoing to find solutions, but there is as yet no commonly agreed approach for these types of assets. Similarly, CO₂e emissions of collateral consisting of small and medium-sized enterprise credit claims are not currently disclosed, which requires the central bank to use rough proxies (e.g. to apply an average estimate based on economic sector level data or apply a *de minimis* rule, etc.).

- More fundamentally, CO₂e accounting issues, such as double counting, imported emissions and indirect emissions, are all the more significant for those central banks that, in order to facilitate the smooth implementation of monetary policy, allow monetary policy counterparties to pledge a very wide variety of asset classes as collateral and that hold diverse asset portfolios.
- While central banks have control over the eligibility criteria applied to asset purchases and collateral, there is a key difference between the carbon footprints of these two types of assets. The composition of the collateral pool is dynamic and to a large extent beyond the control of the central bank, meaning their carbon footprint may be more variable. By contrast, monetary policy outright purchases imply a more direct and often longer-term exposure to the climate-related risks associated with the issuer.

¹ CO₂e means carbon dioxide equivalent, which is used to compare emissions of various GHG on the basis of their global warming potential (GWP) by converting amounts of other gases into the equivalent amount of carbon dioxide with the same global warming potential.

4. Reviewing potential options

4.1. Identifying the options

The menu of options that a central bank could consider in order to factor climate-related risks into its operational framework is, in theory, large. Adjustments could be considered across all the main operational functions that central banks carry out for the purposes of implementing monetary policy: credit operations, collateral and asset purchases.

Nine stylised options are reviewed in the report, covering the three main policy fields outlined above (see Table 3 for the list and descriptions). These have been selected because they are relevant to multiple central banks and

relate to existing tools. Some options represent a greater departure from standard central bank policies than others. Other options for adjusting central banks' operational frameworks are conceivable, and these could be evaluated using the assessment framework detailed in Chapter 3.

The report focuses on potential measures on the asset side of a central bank's balance sheet. It does not look into the liability side of the balance sheet. Hence, the stylised options listed in Table 1 pertain to liquidity-providing instruments, while liquidity-absorbing instruments, i.e. reserve requirements, term deposits, issuance of central bank bills and the like, are not discussed in any detail. However, it is acknowledged that such instruments might also be relevant for central banks,

Table 3. Selected stylised options for adjusting operational frameworks to climate-related risks

Credit operations ^a	
(1) Adjust pricing to reflect counterparties' climate-related lending	Make the interest rate for central bank lending facilities conditional on the extent to which a counterparty's lending (relative to a relevant benchmark) is contributing to climate change mitigation and/or the extent to which they are decarbonising their business model.
(2) Adjust pricing to reflect the composition of pledged collateral	Charge a lower (or higher) interest rate to counterparties that pledge a higher proportion of low-carbon (or carbon-intensive) assets as collateral or set up a credit facility (potentially at concessional rates) accessible only against low-carbon assets.
(3) Adjust counterparties' eligibility	Make access to (some) lending facilities conditional on a counterparty's disclosure of climate-related information or on its carbon-intensive/low-carbon/green investments.
Collateral ^b	
(4) Adjust haircuts ^c	Adjust haircuts to better account for climate-related risks. Haircuts could also be calibrated such that they go beyond what might be required from a purely risk mitigation perspective in order to incentivise the market for sustainable assets.
(5) Negative screening	Exclude otherwise eligible collateral assets, based on their issuer-level climate-related risk profile for debt securities or on the analysis of the carbon performance of underlying assets for pledged pools of loans or securitised products. This could be done in different ways, including adjusting eligibility requirements, tightening risk tolerance, introducing tighter or specific mobilisation rules, etc.
(6) Positive screening	Accept sustainable collateral so as to incentivise banks to lend or capital markets to fund projects and assets that support environmentally-friendly activities (e.g. green bonds or Sustainability Development Goals-linked assets). This could be done in different ways, including adjusting eligibility requirements, increasing risk tolerance on a limited scale, relaxing some mobilisation rules, etc.
(7) Align collateral pools with a climate-related objective	Require counterparties to pledge collateral such that it complies with a climate-related metric at an aggregate pool level.
Asset purchases ^d	
(8) Tilt purchases	Skew asset purchases according to climate-related risks and/or criteria applied at the issuer or asset level.
(9) Negative screening	Exclude some assets or issuers from purchases if they fail to meet climate-related criteria.

a Credit operations are widely used to provide aggregate liquidity and usually take the form of collateralised lending.

b Collateral policy defines the range of assets that can be pledged to secure central bank credit operations, as well as the risk control measures that apply to them.

c Annex 1 expands upon the different approaches for haircuts and valuation adjustments.

d Central banks may buy a variety of assets from both public and private sectors, typically in an effort to exert greater influence on longer-term interest rate levels and spreads while improving market liquidity.

depending on the liquidity environment in their respective jurisdictions. This may provide a starting point for further analyses by the NGFS on this specific field in the future.

This review is without prejudice to each NGFS central bank's mandate, legal environment and individual assessment. It is based on the criteria defined in Chapter 3 and leverages on the practical expertise and experience of NGFS central banks. These assessments are not recommendations, nor are they indicative of members' preferences. Rather, they provide a first collective attempt to compare the considerations which may pertain to different options in a structured and consistent manner.

4.2. Summary assessment

Since monetary policy operational frameworks vary significantly across jurisdictions, this assessment necessarily remains generic, i.e. it is only described at a high level. Strategic choices that cut across the various options (such as metric specification, data availability, risk assessment and risk tolerance) are discussed in Chapter 6.

Adjusting central bank operational frameworks to reflect climate-related considerations more fully is potentially feasible, provided additional central bank-specific work is done. Yet accounting for climate-related risks in central bank operations has to overcome a range of practical and analytical challenges, including data gaps and the difficulties associated with measuring climate-related risks. There is a priori no "one size fits all" option that clearly maximises all four criteria identified in Chapter 3, and central banks face trade-offs when integrating climate-related risks into their operations (see Chapter 6). The assessment below summarises how the selected generic options perform against various criteria. The detailed assessment including case studies from central banks already pioneering the use of specific measures in their operational frameworks can be found in Annex 1.

Consequences for monetary policy effectiveness

Assessing the implications of these options for the effectiveness of monetary policy operations is challenging. While the impact on the flexibility or scope of policy operations can be evaluated in light of practical experience, predicting the broader consequences for the

effectiveness of monetary policy transmission is more difficult. The latter is a function of each central bank's actual operational framework and the financial ecosystem in which it operates. Further jurisdiction-specific work is needed on this aspect, but a few preliminary points can be made.

Several options may run the risk of curtailing, more or less significantly, the scope for central bank operations and the policy space. This risk may be more significant in options that aim to (i) exclude counterparties from credit operations on the basis of their carbon footprint or carbon disclosure; and (ii) screen out assets potentially representing a significant share of the purchasable universe or of eligible collateral. These options can offer a pragmatic way for central banks to mitigate tail risks. Their impact on the monetary policy space depends on their design and how stringent they are.

Options which may materially reduce the available monetary policy space, or which are substantively prejudicial to its efficacy, should be considered and designed cautiously. One key point of vigilance concerns the potential unintended consequences that some options may have for financial stability. When designing concrete measures, central banks need to retain flexibility as regards implementation in order to prevent unintended impacts on their ability to achieve their monetary policy objectives or on financial stability. When implementing climate-related options, central banks need to reserve the right to take account of prevailing financial market conditions, especially in times of market stress, and possibly define "escape clauses".

The implications for the effectiveness of monetary policy of some options may be negligible or still require further assessment in the light of each central bank's circumstances. This is the case for those options that focus on (i) conditioning the pricing of credit operations on a low-carbon lending benchmark; (ii) adjusting haircuts and valuations to account for climate risks; (iii) aligning collateral pools; and (iv) tilting asset purchases.

Contribution to mitigating climate change

A few options may be more impactful from a climate-related perspective than others. These include measures aimed at (i) adjusting the pricing of targeted credit operations to a climate-related lending benchmark; (ii) positively screening collateral; (iii) aligning collateral

pools; and (iv) tilting asset purchases. These measures would typically leverage and foster market mechanisms. They typically consist of modifying existing tools without fully overhauling their design (e.g. leveraging pricing schemes for targeted credit operations) in order to encourage lenders to originate or invest more in low-carbon and transition assets. Seen from this perspective, they could be consistent with the smooth implementation of monetary policy, although still technically challenging to operationalise.

Effectiveness for risk protection purposes

Many of the options reviewed would probably better shield central bank balance sheets against increasing financial risks, notably those options that would directly reduce risk exposure (to issuers or counterparties). The following options are viewed as being probably risk-protective: (i) adjusting eligible counterparties; (ii) adjusting haircuts and valuations; (iii) negatively screening collateral; (iv) aligning collateral pools; (v) tilting asset purchases; and (vi) negatively screening asset purchases. However, for some of them, the potentially positive impact may be diluted, or in some cases even outweighed, if the reduction in the eligible universe leads to higher financial risk concentrations. A priori and contingent on each central bank's mandate, options designed from a financial risk perspective (e.g. negative screening) may be less exposed to legal risks and challenges than others designed to support climate-related objectives, especially if the latter are seen as subsidising some economic sectors, issuers or assets.

For many options, the actual impact from a risk protection perspective is difficult to assess without a more

detailed specification. This is the case for the options consisting of adjusting the pricing of targeted credit operations (i) to a climate-related lending benchmark; or (ii) to pledged collateral. Risk protection and the contribution to mitigating climate change may, in some cases, converge as some operational options serve both purposes (see Annex 1).

Operational feasibility

All options entail significant changes to central bank operational frameworks. Factoring in climate-related considerations may imply procuring additional specialist climate data, adapting IT and reporting systems, revising internal processes, and rewriting operational terms and conditions.

The least challenging options to operationalise are the least sophisticated ones in terms of addressing climate-related risks, but potentially costlier in terms of monetary policy effectiveness. These include (i) adjusting eligibility criteria for counterparties; (ii) screening collateral; and (iii) screening purchasable assets.

Conversely, the options that are less likely to entail adverse consequences for monetary policy effectiveness are typically associated with somewhat **higher operational complexity.** This is the case for (i) adjusting the pricing of targeted credit operations to a lending benchmark; (ii) haircut and valuation adjustments; (iii) aligning collateral pools; and (iv) asset purchase tilting. Whether any additional complexity would be warranted to achieve associated reductions in financial risk or improved climate outcomes would need to be assessed on a case-by-case basis.

Table 4. Simplified comparative assessment of the selected generic options under review

	CREDIT OPERATIONS			COLLATERAL				ASSET PURCHASES	
	(1) ADJUSTING PRICING TO LENDING BENCHMARK	(2) ADJUSTING PRICING TO COLLATERAL	(3) ADJUSTING COUNTERPARTIES' ELIGIBILITY	(4) HAIRCUT ADJUSTMENT	(5) NEGATIVE SCREENING	(6) POSITIVE SCREENING	(7) ALIGNING COLLATERAL POOLS	(8) TILTING	(9) NEGATIVE SCREENING
CONSEQUENCES FOR MONETARY POLICY EFFECTIVENESS	Minimal	Negative	Strongly Negative	Minimal	Negative	Positive	Minimal	Minimal	Negative
CONTRIBUTION TO MITIGATING CLIMATE CHANGE	Strongly Positive	Positive	Positive	Positive	Positive	Positive	Strongly Positive	Strongly Positive	Positive
EFFECTIVENESS AS RISK PROTECTION MEASURE	Minimal	Minimal	Positive	Positive	Positive	Negative	Positive	Positive	Positive
OPERATIONAL FEASIBILITY	Negative	Negative	Minimal	Negative	Minimal	Minimal	Negative	Negative	Minimal

POTENTIAL IMPACT : ■ STRONGLY POSITIVE ■ MINIMAL ■ STRONGLY NEGATIVE
■ POSITIVE ■ NEGATIVE

The assessment is based on qualitative expert judgement, and more formal quantitative analysis may be needed. It aims to guide the reader through the report and should not be interpreted as recommending any measure. Colour-coding is used to avoid any "netting" across criteria. The table uses a limited number of colours for reasons of simplicity. More nuanced analyses of options are provided in Annex 1.

4.3. Open questions

This review highlights two critical questions that central banks need to address. One relates to the sequencing of potential actions. The other to the consistency between them.

Sequencing

Some options are more challenging than others and require significant lead times and preparatory work.

Prioritisation of the options needs to be informed by data. Many central banks may deem it important to improve their access to relevant specialist climate data and their ability to measure climate-specific risks on both a backward and forward-looking basis. While much progress has already been made on relevant metrics, central banks need to embed the use of these metrics both internally and in the financial systems for which they are responsible.

More generally, central banks need to assess whether to adopt a “learning by doing approach” or to design a comprehensive climate-adjusted framework.

The choice between the two depends on their mandate, their financial environment, and the guiding principles underpinning their operational framework. The first approach is likely to imply gradual step-by-step adjustments. It echoes practices at several central banks in the introduction of new monetary policy instruments during recent crises. It can consist of selectively adapting the operational framework, focusing first on those issuers and/or assets for which data and methodologies are more mature and robust.

The second approach is likely to imply longer lead times and/or acknowledging that data and methodologies need to be relied on which may be comparatively less robust for some assets or issuers. In practice, it can consist of adapting the operational framework to the greatest extent, which may entail giving preference to a prudent calibration of the measure from a climate perspective.

Consistency

Central banks have to be mindful of the consistency of their operational frameworks so as to avoid creating unwarranted incentives or unintended consequences, or introducing bias into market functioning. Policy design and the sequencing of climate-related options will likewise need to respect this general principle.

This implies that central banks need to carefully assess whether the climate-related measures they opt for are mutually consistent and/or interdependent.

For instance, they should clarify whether requiring monetary policy counterparties to make climate-related disclosures can be considered independently of other climate-related measures (e.g. in terms of counterparty ineligibility or in terms of credit operations price adjustment). Similarly, depending on how their operational framework is designed, central banks need to assess whether it is consistent to adjust their collateral policy to climate-related risks without considering doing the same for purchases if they both cover similar assets (and vice versa).

5. Disclosure

Enhanced disclosure of climate-relevant data is an operational and policy issue that cuts across the potential menu of central bank policy options.

Disclosure requirements may be imposed by central banks or other public authorities depending on their respective responsibility within their jurisdiction. They could help foster the greater availability of climate-related data and improve the measurement of climate-related risks across the financial system. Data availability seems to be a material constraint to assessing climate-related exposures.¹⁷ Such requirements could be implemented in multiple ways and are not confined to any specific operational framework.

In broad terms, disclosure requirements can take two forms, depending on whether the beneficiary of the enhanced body of information is public or internal. Where this falls within their power, central banks could impose public disclosure requirements on other parties by leveraging commonly agreed or regulatory reporting frameworks. Information disclosed within these frameworks would benefit not only the central bank, but also market participants, other public authorities and economic agents at large. Alternatively, central banks could impose reporting requirements on other parties but keep the data confidential and use it only for their internal assessments. In this case, the enhanced body of information would benefit only the central bank.

Whether climate data should be disclosed only to the central bank or more broadly will depend on the objective of disclosure. If data are collected purely for risk-protective purposes, theoretically they might not need to be made public. But greater disclosure is likely to be more helpful in terms of enabling the market to price climate risk more fully and more consistently with the aim of supporting climate transition.

Central banks should also assess whether or not to disclose climate-related information on their own policy operations and financial activities. This could be motivated by considerations about transparency and accountability to the public about the climate-related

risks and carbon footprint of their operations. It could also serve to signal a central bank's commitment to enhancing climate risk information.

Central banks can play a key role in the development of data, metrics and best practices – and are well positioned to do so, given their experience in setting reporting standards for statistical, supervisory and regulatory purposes. Establishing best practices in the field of climate-related data is likely to be an iterative process.

5.1. Is disclosure a prerequisite for other potential adjustments?

Increased disclosure of climate data is critical for helping central banks to better understand their exposures to climate-related risks. Enhancing disclosures can reduce information asymmetries, contribute to research and analysis on the impact of climate-related risks on monetary policy transmission and operations, and support a better measurement of central banks' exposures to climate-related risks. Over the medium term, regular and standardised disclosures could contribute indirectly to protecting the monetary policy transmission mechanism by reducing potential informational market failures (see Box 2).

Increased availability of climate-related information may, in some cases, be a prerequisite for adjusting operational frameworks. The recalibration of some of the measures explored in Chapter 4 and Annex 1 may require more extensive and robust information than is currently available.

Nevertheless, some climate-related adjustments to operational frameworks could be developed in parallel with data disclosure and reporting initiatives. One adjustment that could potentially be made without additional data is to accommodate climate-related financial innovations (e.g. the development of sustainability-linked bonds) within the eligible collateral universe, where feasible. Other adjustments that could be developed alongside

¹⁷ See, for example, Financial Stability Board (2020).

improvements in data disclosure are those designed for specific sub-categories of operations (e.g. a segment of a purchase programme, a sub-category of collateral), where a central bank deems data quality and availability to be sufficient. Central banks may also opt for workaround solutions (e.g. using sector averages rather than asset or issuer-specific data).

Central banks should aim to strike a balance between waiting for robust and comprehensive data to become available and the risks associated with delaying action.

The cost of acting only once robust datasets and methods are established could be much higher than the cost of acting now given limited information. They should also consider that a dynamic relationship might exist between central bank measures (even if only partial or gradual) and stakeholder incentives to disclose and produce better data and methodologies. However, for policies based on disclosures to be efficient, it is critical that the data to be disclosed are reliable and comparable. Introducing policies before robust datasets and methodologies are available could result in policy measures being inefficient.

Box 2

To what extent does climate-related disclosure affect the pricing of assets (notably fixed income assets)?

Disclosing climate change-related metrics may provide investors with important information on the management of climate-related risks. At the same time, pricing climate-related risks may be difficult if information is not available in a comparable format. In recent years, initiatives to develop and promote harmonised climate-related disclosures have gained momentum. On the one hand, many large companies around the globe are following the recommendations of the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD), albeit with varying degrees of consistency and completeness. On the other, private market data providers have developed what are known as environmental, social and governance (ESG) scores that seek to consolidate quantitative and qualitative environmental information and enhance its comparability.

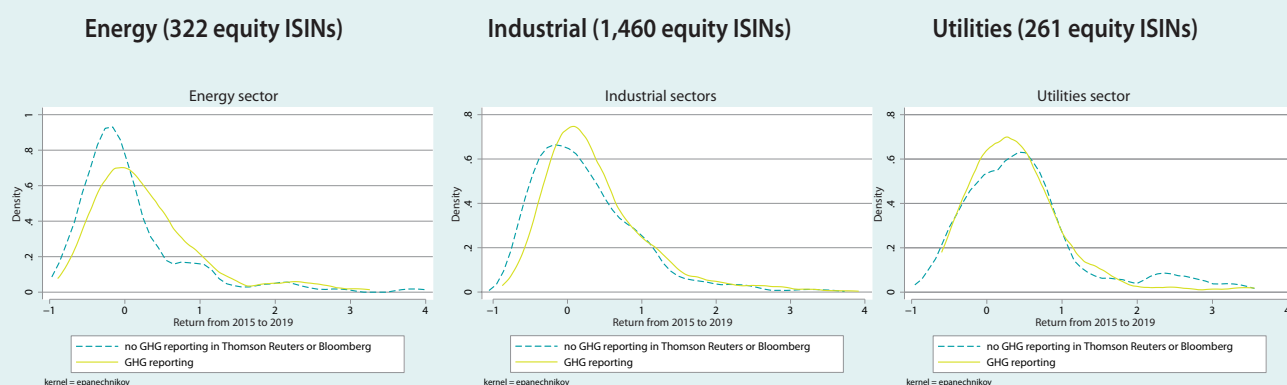
Although academic studies may at first glance appear to paint a mixed picture of the extent to which climate disclosures impact asset pricing, a granular approach does reveal some patterns.¹ For example, investors in

certain energy-intensive sectors (such as mining, cement production or the oil industry) may be more sensitive to climate disclosures by issuers. Chart 1 illustrates the different means of cumulated changes in firm valuations since the Paris Agreement, depending on whether the firm in question reported its carbon emissions according to Thomson Reuters or Bloomberg. The differences are in line with the results of some recent studies which find that environmental disclosures matter for profitability expectations and reduce information asymmetries at least in the most climate relevant activities, such as the energy sector.² Further analysis of the data shows that the risk perception related to a firm not disclosing climate change data may have increased over time, as the difference is stronger for the 2017-19 sub-period. Lastly, looking at different financial market instruments, equity and bond market investors could also respond differently to climate disclosures, depending on whether they expect non-disclosure to signal lower future cash flows or whether it is also thought to increase short to medium-term credit risk. .../...

¹ See, for example, Friede, G., T. Busch, and A. Bassen (2015).

² See, for example, Bolton, P. and M. Kacperczyk (2020); Downar, B., J. Ernstberger, S. Reichelstein, S. Schwenen, and A. Zaklan (2020); Hsu, P.-H., K. Li, and C.-Y. Tsou (2018); Alessi, L., E. Ossola, and R. Panzica (2019); and Bui, B., O. Moses, and M. N. Houqe (2019).

Chart 1. Mean stock price change is higher for firms disclosing carbon emissions in the energy and industrial sectors



Sources: Bloomberg and Thomson Reuters, own calculations.

Notes: Sample comprises 2,043 equity instruments of listed non-financial firms between end-2015 (start of the Paris Agreement) and end-2019. The disclosure measure is defined as a dummy variable that takes the value of one if either Bloomberg or Thomson Reuters provide emission data for the respective firm in 2018, and zero otherwise. Mean comparison tests suggest a non-significant difference in stock price changes in the utilities sector, but significant differences at the 1% confidence level for firms in the energy sector and the industrial sector.

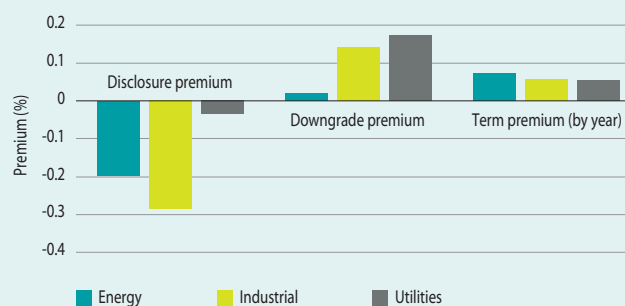
Recently, awareness of the potential impact of climate change on credit risks and therefore its importance for fixed income investors has grown.³ Disclosure of climate metrics related to issuers may be of importance for an investor's credit risk assessment.⁴ Also, investment rules such as exclusion criteria may reduce demand for bonds of issuers that do not disclose climate-related information.

Looking at a snapshot of global investment grade rated corporate bonds suggests that environmental disclosure has a significant and negative impact on bond yields (see Chart 2). The magnitude of this impact is small, however, when compared to the more traditional factors related to term and default premia. Environmental disclosures by issuers, as measured by a positive value of the environmental sub-index of the ESG disclosure score calculated by Bloomberg, decrease bond yields and thus increase bond valuations, in particular in the industrial and energy sectors. This result would suggest that, in line with the patterns observed in stock market studies, bond investors attach the highest premium to transparency on ESG issues in sectors where climate risk may matter most for default probabilities.

³ See, for example, IMF (2019).

⁴ It should be noted that this analysis does not concern what are known as green bonds, which do not imply a different credit risk than other bonds of the same issuer.

Chart 2. Impact of selected variables on bond yields (bonds issued in euro; in percentage points)



Sources: Bloomberg, own calculations.

Notes: Downgrade premium refers to the impact of a credit rating downgrade on a bond's mid-yield to maturity and is used for a proxy for the default premium. The disclosure factor is a dummy variable that takes the value of one if the issuer firm disclosed environmental information as part of its ESG disclosure score provided by Bloomberg in 2017 and/or 2018, and zero otherwise. The chart reflects the results of a cross-section regression of 277 bonds denominated in euro, issued between 2000 and 2019.

The disclosure premium coefficients were significant at the 1% confidence level for the energy and industrial sectors, whereas the coefficient for utilities was not significant. The results for bonds issued in US dollar were qualitatively similar but less significant for the energy and industrial sectors, whereas the disclosure coefficient for the utilities sector was positive. However, the sample for the latter sector in US dollar is very small and therefore not representative. The results remained qualitatively unchanged when the models were tested on out-of-sample data.

5.2. Requiring disclosure from eligible collateral issuers and/or monetary policy counterparties

Introducing disclosure requirements in monetary policy operations could help foster harmonised, transparent, reliable and comparable data. This could be done as part of collateral policy, credit operations, counterparty policy, and/or asset purchase programmes. Disclosure requirements could be imposed either directly on monetary policy counterparties (banks, asset issuers) or indirectly by requiring additional information from counterparties about the underlying assets of securities pledged as collateral (e.g. data on the energy efficiency of buildings for the residential mortgage loans underlying certain securitisation products).

Disclosure requirements can come in various shades. They can serve to enhance the central bank's risk management or promote market transparency in order to address informational market failures and foster climate transition.

- **Disclosure could be mandatory** and serve to discriminate between counterparties, assets or issuers that do not meet prescribed eligibility criteria. Such criteria may be more or less stringent depending on their design (full vs. partial disclosure, with or without a phasing-in period). While powerful, a stricter disclosure approach may potentially conflict with the smooth implementation of monetary policy, if it translates into an excessive exclusion of assets available for monetary policy operations or counterparties.
- **Alternatively, disclosure can be designed more as an incentive.** Monetary policy stakeholders might be encouraged to self-report their climate-related risk exposures, for instance by means of a price incentive in targeted credit operations, a haircut adjustment, or the tilting of asset purchases. For structured finance and non-marketable assets, compliance with a climate-related loan-level reporting standard could be required, incentivising financial institutions to obtain relevant information from their customers. This could increase the

information available on segments where it is currently most limited, such as small and medium-sized enterprises (SMEs) and households. Disclosure requirements may be best suited for risk identification purposes if introduced at the counterparty or collateral level.

Climate-related reporting requirements would come at a cost for reporting agents. Central banks should carefully define their objectives and needs for disclosure (e.g. disclosure by all or only some issuers, assets, or counterparties) as well as any additional verification needs (e.g. whether existing or new requirements are used, what metrics will be calculated, how data will be collected, and who will monitor the process). An adverse selection problem may occur, whereby more-polluting firms may be afforded better treatment due to their more developed disclosures. To avoid placing smaller entities at a disadvantage, simplified requirements may need to be implemented for entities below a given size threshold.

To reduce the operational burden of disclosure requirements and issues associated with comparability and transparency, central banks should seek to leverage existing reporting frameworks, building on Task Force on Climate-related Financial Disclosures (TCFD) and forthcoming International Financial Reporting Standards (IFRS) requirements. Alternatively, central banks could refer to available legal frameworks (e.g. the Non-Financial Reporting Directive (NFRD) in the European Union (EU)).

5.3. Disclosing the central bank's own exposures to climate-related risks

Central banks may wish to disclose information on their own exposures to climate-related risks and on their climate strategy and performance. This would help set a positive example to assist market participants in developing their own disclosure frameworks and incorporating climate-related considerations into their investment and lending decisions (see Box 3).

Box 3

Case study: Bank of England – approach to TCFD disclosures

In 2020, the Bank of England published its first climate-related financial disclosure, setting out its approach to managing the risks from climate change across its entire operations, and the steps taken to improve the central bank's understanding of these risks.

Following the TCFD framework, the report covered the Bank of England's:

- governance structures and processes used to manage climate-related risks;
- approach to setting climate strategy and managing its implementation;
- approach to climate-related financial risk management, including the metrics used to measure and monitor climate-related risks and the climate targets on the central bank's physical operations.

A key section of the disclosure assessed the financial risks from climate change in the central bank's financial asset portfolios, including its portfolios held for policy purposes. This used a range of metrics covering carbon footprint and exposures to physical and transition risks.

By far the largest proportion (96%) of assets held in the Bank of England's financial asset portfolios is held in a separate legal vehicle, to implement the Monetary Policy Committee's (MPC) asset purchase programme. Of this, based on end-February 2020 data, 98% is invested in United Kingdom (UK) sovereign government bonds and 2% in UK sterling corporate bonds. The climate metrics of the Bank's portfolio are therefore materially aligned with that of the UK.

In terms of the carbon footprint, because the UK has the second-lowest carbon intensity in the G7, the portfolio's carbon footprint was lower than a comparable reference index. For the corporate bond portfolio, some more experimental metrics were used in an attempt to assess alignment with international climate targets. These metrics showed that a gap remains between the associated carbon outputs of those holdings and Paris Agreement goals, in line with the economic adjustments required across the economy to meet the UK's goal of net zero emissions by 2050.

Transition risk was assessed by examining portfolio exposures to fossil fuel-related activities, and physical risk was assessed using specialist climate modelling that seeks to identify geographical vulnerabilities. Estimates suggested that aggregate transition and physical risks to the portfolios are modest in the short term – but the Bank of England recognises that there is scope to take this analysis further and is committed to developing its approach as methodologies improve.

This exercise was undertaken with external data providers, as part of looking across a range of metrics. The approach enabled the central bank to cross-check physical and transition risk measures from different sources and helped to advance thinking on the assessment and management of climate-related financial risks. The process also identified a number of current limitations on data, analysis techniques and modelling methodologies.

Some of the lessons learned include:

1. The need to manage some gaps in emissions data. Data for some smaller unlisted corporates can be limited and the reporting of scope 3 data by companies can be inconsistent.
2. The need to look carefully at how metrics are constructed. For example, forward-looking temperature alignment metrics are, in principle, an important analytical tool. However, differences between alternative modelling approaches and the lack of comparability among them can lead to quite different estimates and make it difficult to draw conclusions from them.
3. There are many potential ways to assess transition risk. The report focused on a simple and relatively straightforward measure – exposures to fossil fuel-related activities – but more advanced scenario analysis approaches are a possibility.
4. The outputs of physical risk modelling, in particular, can be difficult to validate independently due to the specialist nature of these climate models.

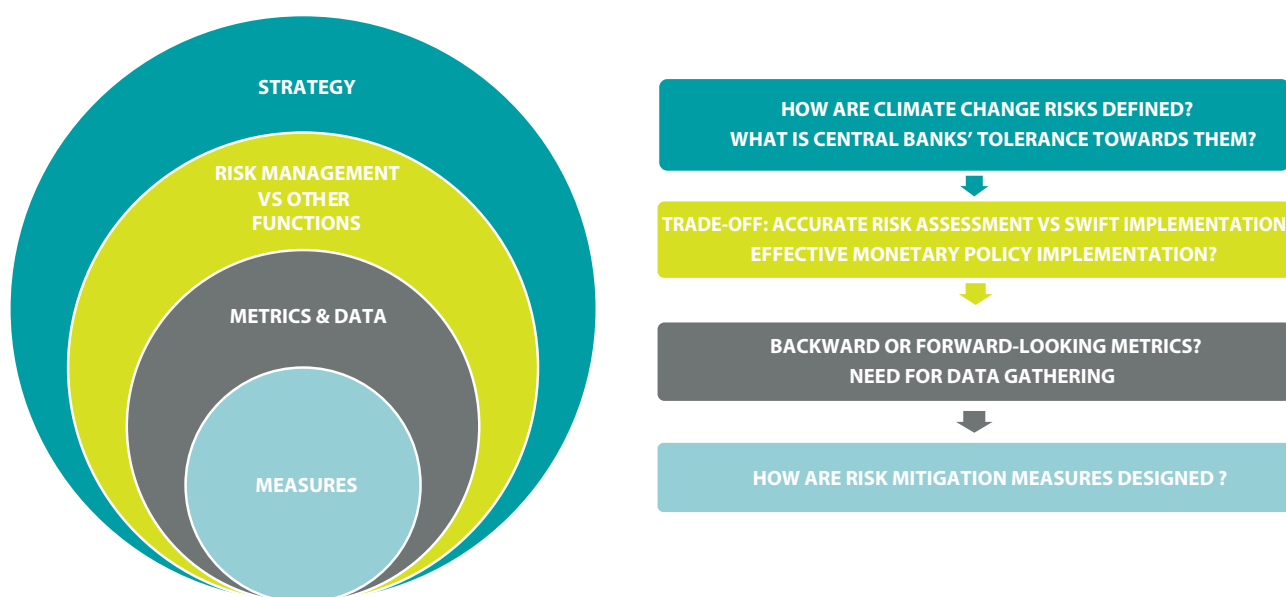
The Bank of England is committed to further enhancing its approach and hopes that its report will help others' engagement with this type of analysis.

6. Strategic choices when dealing with climate change

Looking beyond the specific adjustment options for monetary policy operational frameworks when dealing with climate change, central banks are faced with other overarching strategic issues, which are to a large extent interrelated with one another. Developing a stance on these interrelated strategic issues is a precondition for a

proper evaluation of which adjustments are best suited to each central bank's mandate, legal environment and preferences. Figure 4 maps out, in generic terms, some of the strategic questions that arise throughout the process of incorporating climate-related risks into monetary policy operational frameworks.

Figure 4. Strategic choices for adapting monetary policy operational frameworks to climate-related risks



6.1. Risk tolerance and assessment

Central banks could benefit from developing a clear strategic view of their appetite for climate-related risks, which will depend on their own risk tolerance and that of their institutional environment. Introducing risk-mitigating measures inevitably impacts the design of monetary instruments and their implementation. A central bank's risk tolerance determines to a large extent its assessment of the prerequisites that must be in place if it adjusts its operational framework and if it is willing to deviate from market standard practices. When weighing the importance of climate-related risks, central banks must be mindful of the impact that changes to their risk tolerance may have on the effectiveness of monetary policy (see Chapters 3 and 4).

Central banks can develop in-house climate-related risk assessment frameworks. This can help fully integrate

climate-related risk into their standard credit risk frameworks. One benefit of an internal assessment framework is that it can cover the exact universe of assets and issuers eligible as collateral or for asset purchases and match the horizon of each central bank's exposures. Developing an internal credit assessment system can, however, be challenging and burdensome. In the longer run, such an approach could complement credit rating agencies' scores.

Central banks should decide on how forward-looking they wish their risk mitigation frameworks to be. Traditional risk models are based on historical market pricing data. This approach, while used for standard financial risks, is ill-suited to modelling future climate-related risks, given the very nature of climate change. Historical data are indeed very unlikely to be a good guide to the future (TCFD, 2017). This calls for using scenario-based approaches to climate-related risks. Yet it is challenging to model the financial impacts of

climate-related risks across a range of plausible climate and climate policy outcomes.

One approach to designing climate-related adjustments to monetary policy frameworks would be to apply forward-looking “stress tests” to asset or collateral values using a range of climate scenarios. Climate risk scenario analysis is still a nascent field, and best practices on the quantification of climate-related financial risks is still under development. A more operationally expedient alternative, depending on data quality, may be to apply less sophisticated tools such as precautionary haircut adjustments.

Using external data providers for risk identification has operational benefits. In principle, this is a pragmatic way for central banks to align with best market practices and standards. A precondition for reaping this benefit, to which the central bank can contribute, is the existence of best practices and market standards that are demonstrably robust, in terms of methodologies, data coverage, data quality management, and accuracy. Currently, climate data are not always available at the issuer or asset level, and may need to be approximated using economic sector averages to achieve full coverage. This creates challenges and trade-offs for central banks that typically necessitate more granular (asset-by-asset or issuer-by-issuer) data.

An external, harmonised climate-related taxonomy of activities can help in implementing climate risk measures in a credible and transparent manner. However, taxonomies are not without limitation from a monetary policy operation perspective: they are activity-based, which may be hard to map with cross-sector firms; they are static by nature and run the risk of not capturing risk properly, for instance climate-disruptive technology firms; their revision process can be a source of difficulties for central banks that have plugged their categories and thresholds into their risk control framework, for instance. Alternatively, a central bank’s categorisation of assets, firms or sectors could be based on methodologies developed by external data providers that have identified carbon-intensive sectors and physical risk criteria, and provide carbon-related data on the relevant firms. Categorisation could also be based on a list of national accounting sectors. This approach also comes with drawbacks, such as the treatment of holding or financial subsidiaries of industrial groups, or of cross-sector conglomerates.

6.2. Metrics

Central banks need to have a clear view of the right climate-related metrics to use in order to adjust their operational frameworks. This choice depends on the type of climate-related risks that are targeted (physical risk, transition risk) and the central bank’s own circumstances (e.g. the mandate and the materiality of these risks for the economic and financial system in which the central bank operates). To operationalise climate-related risk measures, central banks must decide what type of data to use. These could range from geographical location, norm-based information (compliance with global standards, e.g. the Paris Agreement), climate/physical metrics (CO₂e tonnes, 2°C alignment), and carbon intensities to financial valuations of climate-related risks or hybrids (see Annex 2 for a brief overview of metrics).

At the current juncture, in the absence of reliable and commonly agreed ways of putting a price tag on climate-related risks, central banks may consider using non-financial climate risk metrics as a pragmatic way of capturing them and designing potential adjustments to their operational framework.

Norm-based metrics have practical benefits, but may prove less appropriate from a risk perspective. They are one way of aligning with market standards or government policies. Norm-based policies can come in different shapes, for example by excluding issuers from countries that have not signed the Paris Agreement or aligning criteria with government taxonomies. They are a relatively simple option to implement, and are often used as a first step towards addressing climate-related risks. Norm-based metrics are typically based on a broad range of incidences that may be valuable for broad risk assessments. However, it would not actually be possible to quantify climate-related risks and risk exposures.

Metrics based on CO₂e emissions offer the advantage of being well-defined and measurable, but they only provide a rough indicator of climate-related risks, without delivering a financial quantification of the risks incurred. The GHG protocol for climate-related information disclosures is a widely recognised standard. This makes CO₂e emissions a suitable option for use as a proxy for an entity’s transition risk exposure. Yet complementary information is needed for an accurate assessment of climate-related

risks: some firms with high current CO₂e emissions might actually incur low transition costs or be rather well-prepared for transition.

More sophisticated ways of assessing transition risks might involve forward-looking metrics. These typically include both quantitative and expert judgement to evaluate the “transition readiness” of economic agents. While they can serve to evaluate assets used in central bank frameworks, these metrics and methodologies are still evolving and subject to additional uncertainties. One potential approach is to align an investment portfolio with target temperature trajectories. Under this approach, the climate-related risk associated with a given portfolio is measured by that portfolio’s alignment with a given temperature target. One advantage of this “alignment” approach is that it leads to a more direct climate-related risk measurement without attempting to translate climate risks into financial risks. A simpler, though still dynamic alternative to these advanced approaches is to use CO₂e emission variations over time.¹⁸

At the current juncture, relying solely on ratings provided by external credit rating agencies is not sufficient to capture climate-related risks. This would require those agencies to take climate-related risks into account more explicitly in their methodologies, which may be difficult given the shorter time horizon considered for credit risk compared to transition risk. For central banks, using credit ratings directly would typically be easy operationally and probably uncontroversial as credit ratings are often used already as a key input in their operational framework.

6.3. Data

Central banks may wish to develop policies to monitor and manage issues surrounding data quality and availability. Data on climate-related risks, such as entities’, projects’ and individuals’ emissions as well as their respective exposure to climate-related risks, are evolving rapidly. They differ from standard financial data in terms of quality, consistency, and availability. Virtually all the possible adjustments that can be made to operational frameworks to capture climate-related financial risks

are crucially dependent on reliable and consistent risk identification and assessment, for which high-quality data are a critical input.

Data availability and accuracy currently act as constraints for climate-related risk metrics, as data may be available only partially or only for certain market segments. Furthermore, diverging data scopes and methodologies across different providers can lead to a divergence of metrics or different degrees of reliability. Self-reported metrics on emissions may also diverge from metrics calculated by private data providers based on a bottom-up assessment of the entity’s business model. The use of multiple metrics and data providers, as well as their selection, is crucial for ensuring that data are sufficiently trustworthy to be used for policy purposes. Central banks cannot meet the data gap alone, and a collective effort is needed to make reliable climate data more widely available.¹⁹

Against this backdrop, central banks that are able and willing to adjust their operational frameworks need to define their tolerance to data uncertainty. As mentioned in Chapter 5, they might wish to play a catalyst role in improving data quality and availability by introducing data disclosure requirements for entities with which they interact in monetary policy operations.

For central banks, discrepancies in disclosures between larger, listed organisations and smaller ones, or across economic sectors create challenges. For central banks, using incomplete data may give rise to level playing field issues, unless they develop, for operational purposes, statistical approaches (e.g. internal approaches) to overcome or circumvent data gaps. Fostering initiatives to improve disclosures can help avoid the unequal treatment of certain sectors or firm sizes. In doing so, attention needs to be paid to the fact that disclosure requirements might place a disproportionately heavy burden on smaller firms. Authorities with a relevant mandate could grant these smaller firms a longer period to enhance disclosure requirements or introduce size thresholds for compulsory disclosures (as in the EU NFRD). They could also request information in a way that is proportionate to sectors’ exposure to climate change and thus to the amount of climate risk that entities are exposed to.

¹⁸ See Ehlers et al. (2020) for a proposal.

¹⁹ See, for example, Financial Stability Board (2020).

6.4. Balancing trade-offs

The high standards for risk measurement accuracy typically favoured by central banks cannot currently be met when it comes to climate-related risk assessment.

As accountable public institutions, central banks favour and design risk frameworks that meet the highest standards. Yet there is no clear consensus on what the most appropriate metrics are; data gaps exist, and modelling climate risks is challenging. Currently, operationally feasible approaches to adjusting operational frameworks may have some limitations in terms of their accuracy.

Against this backdrop, central banks face trade-offs if they decide to address climate-related risks.

On the one hand, there are legitimate reasons for them to wait for a consensus to emerge on the most accurate approaches to climate-related risks and for all conditions to be in place for a fully informed risk assessment. Indeed, as public, accountable institutions, central banks differ from private financial institutions. It may prove risky from a reputational and legal perspective to introduce mitigation measures

for climate-related risks without sufficient knowledge. If they turn out to have been ill-informed, produce unanticipated side effects, or adversely impact monetary policy transmission, central banks' credibility could be at stake and they may be exposed to increased legal risks.

On the other hand, climate-related risks may currently lie unchecked on their balance sheets, possibly even more so for central banks that have implemented large-scale crisis measures.

The fact that climate-related risks are difficult to measure accurately and are radically uncertain would actually point towards central banks adopting gradual, predictable and precautionary risk protection measures. Given these considerations, as well as the magnitude of the challenge ahead, central banks stand to benefit from experimenting with pilot projects on specific portfolios or asset classes for climate risk mitigation, as a starting point. They may also benefit from sharing the ideas and knowledge they gained from adapting their operational frameworks to climate risks (see Annex 3). This could inform and pave the way for timely risk management measures.

Annex 1. Detailed review of options

The range of options a central bank faces when considering whether to factor climate-related risks into its operational framework is potentially very large.

Adjustments could, in principle, be considered in all the main operational policies that central banks implement for monetary policy purposes: credit operations, collateral and asset purchases.

For reasons of efficiency, only a few stylised options are reviewed here. These were chosen because they are deemed sufficiently generic and relevant across different central banks. Most options leverage existing central bank tools. However, some would imply departing, more or less significantly, from their standard objectives or design. They cover the three main operational policies mentioned above (see Table 3). Their choice was informed by proposals published in recent months in various forums (see Annex 4 for a list).

This review is without prejudice to each NGFS central bank's individual assessment. It is based on the criteria defined in Chapter 3 and leverages the practical expertise and experience of NGFS central banks. These assessments are neither recommendations nor indicative of members' preferences. Rather, they provide a first collective attempt to compare different options in a structured and consistent manner.

Since operational frameworks vary significantly across jurisdictions, the assessment remains at a high level. In practice, a thorough assessment would require detailed specifications to properly account for each central bank's preferences and circumstances.

Table 5. **Selected stylised options for adjusting operational frameworks to climate-related risks**

Targeted credit operations	Adjust pricing to reflect counterparties' climate-related lending Adjust pricing to reflect the composition of pledged collateral Adjust counterparties' eligibility
Collateral	Adjust haircuts Negative screening Positive screening Align collateral pools with a climate-related objective
Asset purchases	Tilt purchases Negative screening

1.1. Targeted credit operations

Description of the measure

Central banks could adapt their credit operations to target climate-related risks. Climate-adjusted targeted credit operations could steer bank lending towards projects and agents that are less exposed to climate-related risks or that aim to finance climate change mitigation efforts. In practical terms, such climate-related adjustments could comprise making the conditions for central bank operations dependent on compliance with climate-related credit lending benchmarks, desired changes to the collateral pools for targeted operations, and/or specific eligibility criteria for monetary policy counterparties. Different combinations of these parameters could be considered, depending on policy objectives, the structure of financial markets and other local circumstances.

Adjusting pricing to reflect counterparties' climate-related lending

The central bank could offer attractive interest rate conditions to encourage commercial banks to increase their lending to projects and agents that actively contribute to climate change mitigation or adaption and decarbonise their business model.

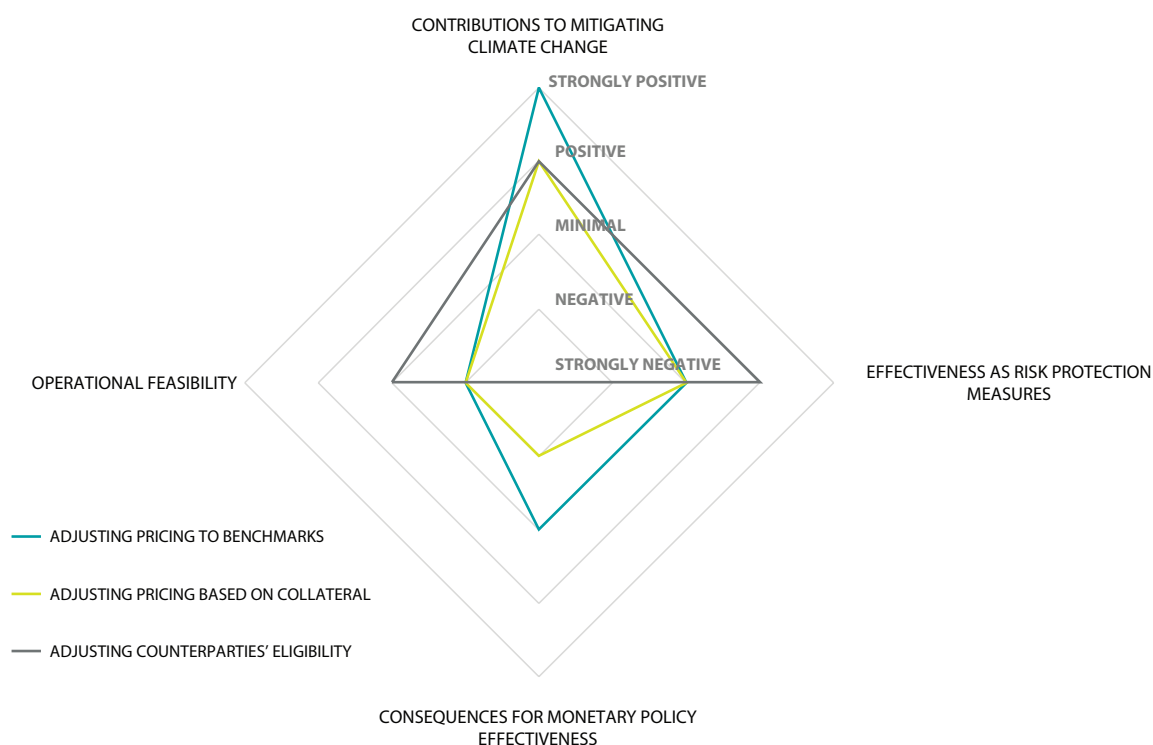
Adjusting pricing to reflect the composition of pledged collateral

The central bank could offer lower (higher) interest rates to counterparties pledging low-carbon (carbon-intensive) assets as collateral.

Adjusting counterparties' eligibility

Central banks could make access to lending facilities conditional on a counterparty's exposure to carbon-intensive, low-carbon or green investments and/or sectors, or introduce a requirement for counterparties to disclose their climate profiles.

Figure 5. Targeted credit operations. Comparison of climate-related measures



Consequences for monetary policy effectiveness

Adjustments to credit operations, if they are specifically targeted at low-carbon and green investments, may alter the usefulness of such schemes for monetary policy transmission to a wide set of economic agents. Indeed, depending on their actual design, such adjustments could result in a curtailing of SMEs' and households' access to bank lending, as these agents are less well equipped to disclose and certify that their investment needs or projects are climate-friendly, unless central banks and/or financial intermediaries are mindful to this particular issue. By contrast, larger corporates, including those with more carbon-intensive business models, are often already obliged to disclose climate-related information. Because of these different disclosure practices across economic agents, climate adjustments to credit operations could asymmetrically benefit those banks that service large corporates, as well

as those corporates themselves, potentially distorting their market share.

More generally, depending on how stringent their design is, climate-related adjustments may conflict with the policy objectives of existing central bank facilities, for instance if they result in a reduction of the maximum amount banks can borrow. This consideration would be particularly important in times of crisis, when central bank targeted lending schemes are typically deployed.

Contributions to mitigating climate change

Credit targeting has the potential to tackle what some see as the existing carbon bias in both bank lending and corporate bond markets.¹ It is hoped that banks would pass better funding conditions on to low-carbon and greener borrowers, thereby lowering the overall cost of low-carbon and green investments.

¹ See Popov and Haas (2020) and Matikainen et al. (2017).

Adjusting credit operations through counterparty eligibility criteria could influence lending behaviour, encouraging lenders to originate or invest more in low-carbon and greener assets. If carbon-intensive funding were to weigh on banks' ability to access central bank credit operations, this measure may lower demand for such assets and increase their funding costs. Conditions based on counterparties' disclosure or climate strategies may enhance market practices, promote transparency, and encourage the inclusion of climate-related risks in banking operations.

Depending on the structure of financial markets in which a central bank operates, combining the different adjustments could maximise the capacity of credit operations to steer funding towards low-carbon projects. On the other hand, greater complexity may discourage uptake of the programme, in particular by smaller commercial banks.

Effectiveness as risk protection measures

In principle, adjustments to credit operations may help to address both physical and transition risks. The parameters modifying the eligibility of collateral and/or counterparties could be efficient in addressing

climate-related risks in case they are not properly accounted for in the market. Central banks can protect their own balance sheets by increasing their funding price or reducing the funding available to banks exposed to climate risks and/or for collateral exposed to climate-related risks.

Operational feasibility

Climate-specific adjustments may increase the complexity of central bank facilities. Past experience has shown that the higher the complexity of adjusted targeted lending schemes, the lower the likely take-up by banks, and the less effective they may be in achieving their objectives.

Climate adjustments to central bank facilities may involve significant operational, legal, and reputational challenges, although the existence of various labels for identifying green and low-carbon assets could help minimise some of these operational complexities. While significant efforts have been made to achieve more standardised market classification practices, existing climate-related labels allow for significant degrees of discretion on the part of issuers and banks. Central banks may consider leveraging their counterparties' own climate-related initiatives, rather than relying on disclosures by SMEs and households.

Box 4

Case study. Bangladesh Bank

Bangladesh is committed to pursuing low-carbon green development without compromising on the imperative of faster economic growth and social development. Development strategies that the Government of Bangladesh laid down in the Perspective Plan (2010-21) and the Sixth Five Year Plan (2011-15) articulate a clear commitment to pursuing sustainable growth. The country's vulnerability to floods and cyclones, and to the threat of large coastal areas being inundated by rising sea levels as a result of global warming makes sustainability a prime concern. Financing practices can crucially influence the pace at which environmentally sustainable output practices are adopted in the real economy. Cognisant of its responsibility for establishing socially and environmentally

responsible practices in the financial sector, Bangladesh Bank, the central bank of Bangladesh, has spearheaded the adoption and promotion of green banking practices throughout the financial sector, towards safeguarding environmental sustainability (Millat, 2012).

Bangladesh Bank's legal mandate is defined as: "[...] to manage the monetary and credit system of Bangladesh with a view to stabilising domestic monetary value and maintaining a competitive external par value of the Bangladesh Taka towards fostering growth and development of [the] country's productive resources in the best national interest." (Bangladesh Bank Order, 1972, Bangladesh Bank (Amendment) Act, 2003). .../...

Though sustainability is not officially part of its mandate, Bangladesh Bank is among the pioneers worldwide in proactively using its monetary policy toolkit to green Bangladesh's financial system. In this vein, it is mobilising funding to adopt sustainable low-carbon practices in the private sector which constitutes over four-fifths of the economy (Kazemi, 2015). While Bangladesh Bank's green central banking activities cover almost the entire range of potential policies (Suttor-Sorel, 2017), this case study focuses on its green refinancing programmes. These programmes work by making funding available to financial institutions and banks at lower rates provided that lending is directed towards targeted segments of the economy (Vaze et al., 2019, Barkawi and Monnin, 2015). Bangladesh Bank launched its first green refinancing line in 2009, with an initial focus on solar energy, biogas, and effluent treatment projects, but since then, the scope of the Refinance Scheme for Environment Friendly Products/Initiatives has been continuously expanded (Barkawi and Monnin, 2015). The size of the fund was doubled recently from USD 25mn to USD 50mn and now covers 55 product lines belonging to nine categories. The Refinance Scheme for Environment Friendly Products/Initiatives was followed by a Refinance Scheme for Islamic Banks in 2014 to promote lending by these institutions to green segments of the economy.

More recently, Bangladesh Bank has launched a Green Transformation Fund of USD 200mn targeted at the export-oriented textile and leather industries. Established in 2016, the Green Transformation Fund provides funding for sustainable initiatives, including energy generation and waste management. Banks accessing the Green Transformation Fund can borrow from Bangladesh Bank at LIBOR+1% and are expected to lend to the private sector with a margin of between 1.00% and 2.00% of the cost of borrowing (Vaze et al., 2019). The tenor of the

loans is 5 to 10 years, a horizon that is suitable for many sustainable investments. The rather long tenor of the loans fills an important gap in Bangladesh's financial system, where the corporate bond market is still underdeveloped and traditional bank lending is usually only provided for maturities of up to 5 or 7 years (Barkawi and Monnin, 2015). In 2019, the scope for the USD component of the Green Transformation Fund was expanded to cover all export-oriented industries, and in April 2020 an additional fund of EUR 200mn was introduced alongside the USD 200mn facility. The euro component of the Green Transformation Fund has also given scope for importing green capital goods and can be used to import industrial raw materials for use in all manufacturing enterprises.

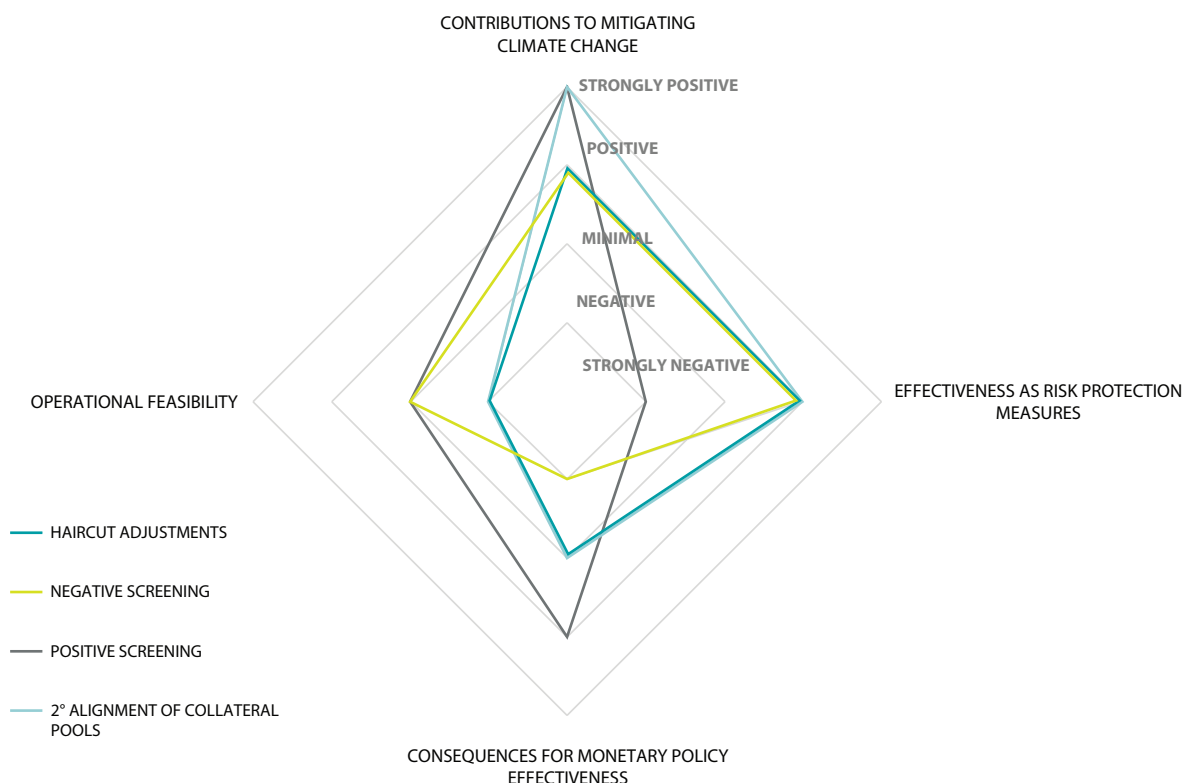
Given the dominance of bank lending in Bangladesh's financial system alongside informal funding sources (Barkawi and Monnin, 2015), Bangladesh Bank's green refinancing activities have been, and are likely to remain successful in promoting funding for sustainable projects. By providing incentives for commercial banks to spot new, green loan opportunities, green refinancing lines are a powerful tool to catalyse the transition towards a sustainable financial system (Barkawi and Monnin, 2015). The green initiatives and green practices of Bangladesh Bank have led to the introduction of a Sustainable Finance Policy, which has structured not only Green Taxonomy but also Sustainable Finance Taxonomy. Sustainability Rating by Bangladesh Bank is now in practice to assess performance of financial institutions on environmental, social and governance attributes. Looking ahead, Bangladesh Bank is currently working on developing Sustainable Banking Policy and Sustainability Reporting along with Green Branch Policy, Green Bond Policy and other related policies aimed at further greening Bangladesh's financial system.

1.2. Collateral

Four generic adjustments of collateral frameworks to climate-related risks are examined: (i) adjusting haircuts; (ii) adapting collateral eligibility criteria, with negative

screening; (iii) adapting collateral eligibility criteria, with positive screening; and (iv) aligning collateral pools of counterparties with sustainability objectives. These measures would produce effects of varying intensity depending on their calibration.

Figure 6. Collateral. Comparison of climate-related measures



A) Haircut adjustments

Description

Central banks use haircuts or valuation adjustments to take the risks of an asset into account. Strictly speaking, haircuts are typically designed mostly to cover market risks in case the asset needs to be liquidated. The term “haircut” is also used in a more general sense to capture other risk-based adjustments to an asset’s value, including those motivated by the uncertainty surrounding model-based pricing, where relevant. Climate-adjusted haircuts potentially come in different shapes and sizes, depending on their motivation.

Climate haircuts could be used to capture risks that go unaccounted for in standard haircut calibrations.

For example, higher haircuts could be applied to more carbon-intensive assets in an attempt to reflect the additional climate-related risks in future transition scenarios, especially in cases where markets fail to price them in adequately. Haircuts on carbon-intensive assets could also be set above and beyond what is required for risk mitigation purposes so as to actively discourage the pledging of carbon-intensive collateral and, hence, indirectly discourage investment in those economic activities (“penalty haircuts”).

Conversely, a central bank could assign a higher collateral value (“supporting haircuts”) to assets from less carbon-intensive sectors. In both cases, such adjustments would be designed to influence, at the margin, the financing conditions for assets according to their contribution to climate-related risks.

Both of these options could be combined by means of a sliding scale approach.² Schematically, for firms operating in the same economic sector, a haircut add-on (or discount) could be applied to the assets issued by the comparatively more (or less) carbon-intensive firm. Such a scheme would yield a continuous incentive for firms to reduce their emissions, while safeguarding a level playing field across sectors and sectoral neutrality.

Moreover, relying on a dynamic approach using metrics that aim to capture efforts by issuers to address climate-related risk (e.g. by reducing their carbon emissions) allows issuers' commitment to transition to be taken into account. Adjusting haircuts according to such metrics would factor in expected changes in issuers' resilience to transition scenarios.

Figure 7. **Haircut. Example of a climate adjustment factor using a sliding scale approach**

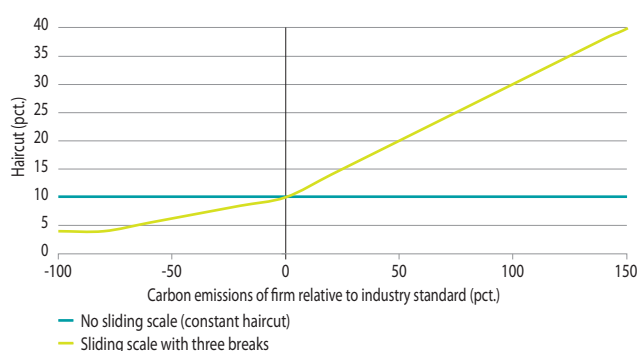


Figure 7 illustrates two haircut regimes. Green line: a fixed haircut of 10 pct. Yellow line: a sliding scale haircut, with a minimum of 4 pct., that increases slowly until firms' carbon emissions reach the sectoral standard and then rises quickly.

Consequences for monetary policy effectiveness

In normal circumstances, because haircut schedules have a second-order influence on the transmission of monetary policy, climate-adjusted haircuts are expected to have limited implications for the implementation of monetary policy. If climate-revised haircuts are calibrated

appropriately, there is no reason why they should affect the transmission mechanism for monetary policy beyond what regular haircuts normally do.

Potential side effects could nevertheless arise, depending on their calibration. Overly restrictive haircuts may constrain access to central bank liquidity. Calibrating climate-adjusted schedules such that the post-haircut collateral volume remains constant on aggregate can help circumvent this problem. From this perspective, a sliding scale of climate-adjusted haircuts may have its advantages. A haircut discount for low-carbon assets can result in stronger demand for those assets, fostering liquidity in those markets and, hence, supporting the smooth transmission of monetary policy.

Contributions to mitigating climate change

Overall, adjusting haircuts for climate-related risks could help mitigate climate change at the margin. Experience has shown that haircuts can influence the preferences of monetary policy counterparties to invest in, originate, and pledge some assets as collateral. However, adjusting haircuts is likely to have a second-order impact relative to the other measures reviewed, notably negative screening.

Adjusting valuation haircuts to address climate-related risks will modify the relative value of eligible assets. It could increase the marginal funding costs of issuers in the most carbon-intensive sectors and, as a result, incentivise them to engage more in transition. It could also induce, at the margin, collateral issuers to change their debt issuance practices to benefit from a better haircut. The use of static carbon intensities can, however, be problematic. This would, for example, penalise utilities that produce high emissions but have improved considerably over time and need funding to make further improvements.

Compared with other haircut options, a sliding scale approach that penalises and rewards issuers according to their climate-related riskiness is likely to have the broadest impact.

2 This suggestion is inspired by fiscal carbon feebates (see, for example, IMF WEO, October 2020). Within an industry, feebates apply, on the one hand, a sliding scale of fees to firms with above-average emission rates and, on the other hand, a sliding scale of rebates to firms with below-average emission rates.

Effectiveness as risk protection measures

Differentiating haircuts based on climate-related risks can mitigate residual risks that are potentially not well captured by existing risk management frameworks.

This is contingent on the existence of robust climate-related risk measures. Calibrating a haircut in the absence of commonly agreed methods for measuring the monetary value of climate-related risks remains a challenge. If collateral is expected to be liquidated within a short time horizon, the exposure to climate-related risks may not materialise.

Applying a haircut discount (add-on) may have adverse side effects.

It can expose central banks to higher (lower) financial risk if the assets subject to the haircut discount (add-on) remain, *ceteris paribus*, exposed to the same level of financial risk – i.e. if there is no clear correlation between standard financial risks and climate-related financial risk. The greater the adjustment, the broader the range of assets, and the further the adjustments go beyond pure risk protection calibration, the larger the magnitude of this potential adverse side effect would be.

From a calibration perspective, the timing mismatch between the assumption about the time needed to liquidate the collateral subject to the haircut calibration and the horizon of climate-related risks makes it challenging to set haircut levels robust to all scenarios.

Operational feasibility

Haircut calibration requires substantial data inputs, as central banks typically accept a broad range of assets as collateral.

Existing climate-related data gaps may limit what central banks are able to achieve in terms of haircut adjustments.

A well-defined taxonomy of climate-relevant activities or thresholds can facilitate the design and communication of climate-adjusted haircuts.

Haircut discounts may be challenging to calibrate robustly, pending further advances in climate risk modelling.

While there is a growing consensus about which sectors contribute most to GHG emissions on a scope 1-3 basis, there is less of a consensus on the exact risks associated with particular transition pathways or

which sectors are best placed to mitigate climate change over time. In the absence of this information, the design of climate-related haircuts may be subject to “pick the winner” problems. Calibration would also have to take into account the additional complexity of quantifying climate risk against other risks (e.g. credit risk), resulting in a single haircut schedule.

Moreover, haircut calibration may be easier, in operational terms, for issuer-specific bond collateral than for securitised bonds or pools of loan collateral.

B) Screening

1. Negative screening

Description

Negative screening means making some assets ineligible as collateral, based on e.g. sectoral criteria, compliance with an external norm and/or climate-related risk characteristics of issuers or assets.

Negative screening may shield central banks from certain risk types, but its main rationale goes beyond risk protection. Indeed, it seems unlikely that an asset with a positive market value could lose all its value because of climate change over the typical maturity of monetary policy credit operations. Negative screening would typically target assets most exposed to climate-related risks: this would contribute to mitigating the central bank’s exposure to climate-related tail risks, such as transition risks.

There are a range of negative screening strategies.

These can be ratings-based (e.g. ESG ratings), rely on compliance with a given norm (e.g. countries or companies not respecting international conventions on climate change), geographical, or sectoral (e.g. exclusion of fossil fuels in general). They can be applied at the asset, issuer or economic sector level.

Consequences for monetary policy effectiveness

The impact on the smooth implementation of monetary policy would largely depend on the breadth of negative screening. If negative screening is broad, applied to a very

large range of asset classes or based on excessively stringent metrics or criteria, it could restrict the participation of banks in lending operations. That said, screening strategies are typically most relevant at issuer level and generally target non-financial corporates. If corporate bonds and loans generally represent a limited share of the eligible collateral universe, the overall impact on monetary policy implementation may be contained.

Regardless of their modalities, screening strategies are likely to come into direct conflict with the level playing field and residual risk equivalence principles. Depending on its design, the measure could impact differently on the largest and smallest issuers (or debtors) or create distortions across asset classes.

Contributions to mitigating climate change

Since the eligibility of an asset as collateral typically influences its liquidity and market price, negative screening is likely to have a stronger impact than climate-adjusted haircuts. Screening-based collateral policies would probably have a greater effect on the market value of excluded assets than the haircut adjustment approach. In fact, an exclusion-based policy is equivalent to applying a 100% haircut to the targeted assets. This could support the transition to a low-carbon economy by raising the marginal funding costs of excluded firms. That said, depending on its modalities, negative screening may have adverse impacts on the transition as they could indirectly disrupt the funding strategies of issuers engaged in decarbonisation.

Effectiveness as risk protection measures

Negative screening could help limit tail risks, albeit in a rather crude fashion. It would probably lower the risk profile of central banks' balance sheets.

Because it is a rather crude approach, excessively broad negative screening could adversely affect the central bank's protection against financial risk. The risk efficiency of negative screening depends on the robustness of the climate-related risk metric used to discriminate among assets. Moreover, to the extent that collateral availability may be curtailed, this approach can drive up concentration risks at

the central bank. Moreover, excluded assets, despite being those most exposed to climate risk, may well also be those least exposed to credit risk. While negative screening would only protect the central bank from assets most exposed to climate-related risk, it would not address the residual climate risks associated with collateral that is still eligible. It may also expose the central bank to reputational and legal risks.

Operational feasibility

Operationally, negative screening is a comparatively easy way of incorporating climate-related risks into collateral frameworks. This is especially the case when screening is based on a taxonomy or norms.

Negative screening would benefit from increased data availability and a sound taxonomy to identify carbon-intensive issuers and assets. This is particularly the case for asset-level screening criteria (vs. norm or economic sector), as the negative screening of non-compliant issuers can otherwise lead to a large loss of collateral. The measure requires a commonly agreed view to identify which activities or entities are most at risk due to climate change.

2. Positive screening

Description of the measure

Central banks can expand the scope of eligible assets to include certain types of assets that fund transition or environment friendly activities (e.g. green bonds or sustainability linked assets³). In practice, this can be achieved in various ways, e.g. by adjusting the requirements for certain collateral features (e.g. coupon or principal), increasing the tolerance for asset complexity, increasing the geographical coverage of assets, or relaxing mobilisation rules (e.g. pool concentration limits or own-use of assets). To some extent, such an approach could leverage market standards (e.g. for green bonds or green loans, where available)

Consequences for monetary policy effectiveness

This measure would most likely have little negative effect on the effectiveness of monetary policy instruments.

3 Sustainability linked assets are marketable assets characterised by a complementary remuneration feature triggered upon achievement of KPIs linked to environmental objectives by the issuer.

If anything, the policy would expand the universe of eligible collateral without affecting regular collateral and would most likely be consistent with a smooth implementation of monetary policy.

Contributions to mitigating climate change

Positive screening helps support the transition of issuers towards more sustainable business models and investments. Positive screening would signal the central bank's willingness to improve financing conditions for low-carbon projects through the "eligibility premium" incorporated in the price of loans issued to finance these projects. The measure may improve the liquidity and attractiveness of green and low-carbon assets, and incentivise monetary policy counterparties to green their balance sheets. This measure may also foster the deepening of domestic sustainable bond and loan markets.

Effectiveness as risk protection measures

Positive screening could result in a higher risk exposure, to the extent that positive screening implies higher risk tolerance towards green or low-carbon assets, except if a better climate profile is strongly correlated with better credit risk. *A priori*, the cruder the screening criteria used by central banks (e.g. sector-level screening vs asset-level screening), the higher the increased risk

exposure. Moreover, such an approach may face adverse selection problems.

Operational feasibility

The implementation of positive screening may be more or less challenging depending on the choice of criteria used to screen green or low-carbon assets. Where the market for green or low-carbon assets is less developed, this measure could face obstacles such as green asset shortages.

Some variants of positive screening may be easier to implement, less susceptible to create market distortions, and less vulnerable to greenwashing than others. This would likely be the case for measures that grant low-carbon assets selective derogations from certain collateral mobilisation rules. For instance, counterparties may be authorised to pledge "in own use" the assets they have issued or originated if they are low-carbon or green. Similarly, where applicable, exemptions to concentration limits could be granted for low-carbon assets, though this may have some negative impacts on the overall risk profile.

Yet to effectively implement any variants of positive screening, the central bank would need to have clear, transparent, and robust definitions of green and low-carbon assets, in order to avoid inadvertently favouring greenwashing.

Box 5

Case study. The People Bank of China's treatment of green bonds as collateral

In 2014, the People's Bank of China (PBoC) launched the medium-term lending facility (MLF), a 3-to-12-month credit facility provided against eligible collateral. This facility accounts for an important part of the credit the central bank provides to Chinese banks. Before June 2018, the following assets were eligible as collateral under the MLF: government securities, local government debt, policy financial bonds,¹ central bank bills, and AAA-rated corporate bonds.²

On 1 June 2018, the PBoC announced three changes to the MLF collateral framework. First, the PBoC expanded the eligible collateral universe to include green bonds, bonds issued by SMEs, and bonds issued by agricultural corporations. Second, the PBoC lowered the credit quality requirement on all eligible bonds from AAA to AA. Third, at the early stage of this expansion, SMEs' bonds, green bonds as well as SMEs' and green loans were granted first-among-equals status.

The measures increased the MLF's eligible bond collateral by an estimated 400-600 billion yuan (equivalent to

USD80 billion).³ This eased the collateral shortage that small and medium-sized financial institutions were suffering in the Chinese domestic market.

The changes to the collateral framework qualify as proactive mitigation of climate change. The expansion targeted, amongst others, green bonds and loans, which were previously excluded from the collateral framework. Furthermore, through its first-among-equals policy, the PBoC temporarily favoured the funding of green projects. In this way, the changes to the collateral framework signalled that, *ceteris paribus*, the PBoC would differentiate between bonds with similar characteristics depending on fund allocation, and, in so doing, make the financing of the green economy more attractive.

The changes to the collateral framework cannot be seen as risk-protective. The reason for this is that the PBoC did not associate green bonds with a better level of credit quality than comparable non-green bonds.

1 Bonds issued by the China Development Bank, the Agricultural Development Bank of China, and the Export-Import Bank of China. See *FTSE Russell*.

2 See PBoC Press release (June 1, 2018).

3 See Fang, H., Y. Wang, and X. Wu (2020).

C) Aligning collateral pools with a climate-related objective

Description of the measure

Counterparties can be required to align the collateral they pledge so that the collateral pool complies with a predefined climate-related risk metric (e.g. carbon intensity measure or warming objectives). The metric used can be static, such as the weighted average carbon intensity (WACI), or build on forward-looking alignment metrics⁴. These metrics include: (i) relative gap (in %) between the historical and projected emissions over a predefined period and a 2°C

emission budget trajectory; (ii) decarbonisation metrics used as a proxy for portfolio alignment (such as avoided/induced carbon emissions, or carbon intensity per unit of revenue); and (iii) synthetic rating based on a range of indicators (economic activities, investments and R&D expenditures, the entity's positioning and strategy regarding the low-carbon transition).

Consequences for monetary policy effectiveness

Aligning collateral pools may be compatible with the market-oriented conduct of monetary policy. Indeed, if counterparties meet the alignment criteria they could

4 Methodology and discussion are detailed in TCFD Knowledge Hub, Portfolio Alignment Team's report (2020). A practical experiment can be found in Oustry et al. (2020).

freely manage and optimise the composition of their collateral pool. In this context, an option of this kind may be more consistent with the typical principles underpinning monetary policy implementation than screening policies.

However, depending on the availability of aligned assets, counterparties may face challenges in flexibly constituting an aligned collateral pool and managing it over time. The central bank would need to carefully assess the amount of eligible collateral that could be considered aligned under different alignment constraints, before implementing such a new requirement. Contingent on the alignment technique and the actual transition efforts of issuers, the requirement may imply a significant decrease in corporate assets in the pledged collateral.

Contributions to mitigating climate change

Contingent on the robustness of alignment methods, requesting counterparties to align collateral pools would imply that a central bank's collateral does not hamper the transition to a low-carbon economy. Besides, it would incentivise banks and market participants to gradually adjust their own investment preferences towards low-carbon assets. This measure would also boost awareness surrounding the existence of non-aligned assets, which are more likely to be at risk of becoming stranded. More generally, this measure could potentially foster a gradual change in relative prices between assets with different degrees of carbon intensity, leveraging on market forces.

Compared to more direct measures like negative or positive screening, aligning collateral pools may, however, contribute only gradually to reducing climate-related risks. Indeed, alignment approaches consider decarbonisation as a process over time, rather than as a point-in-time achievement⁵.

Effectiveness as risk protection measures

Alignment requirements can reduce exposure to transition risks. They can reduce the aggregate risk

exposure while safeguarding the risk mitigation benefits of collateral pool diversification. Yet forward-looking alignment methodologies are still work in progress and not mainstream in portfolio management.

Operational feasibility

Unlike other climate-adjusted collateral measures, pool alignment requirements would typically constitute a new type of rule and would most likely increase complexity. Compliance with the criteria would need to be monitored, adding an operational burden for both the central bank and monetary policy counterparties.

Central banks would have to decide on which alignment criteria to use. Operational feasibility would depend significantly on the availability of reliable data sources and the metrics used. The choice of these criteria would have to strike a balance between the relevance of the metric, and its coverage of eligible collateral.

1.3. Asset purchases

Compared to collateral measures, asset purchases create a more direct exposure to climate risks for central banks, all the more so if assets are held to maturity. Since climate-related risks are probably not yet fully captured in standard credit risk metrics, central banks could consider adopting climate-related adjustments to their asset purchases in the implementation of their monetary policy framework.

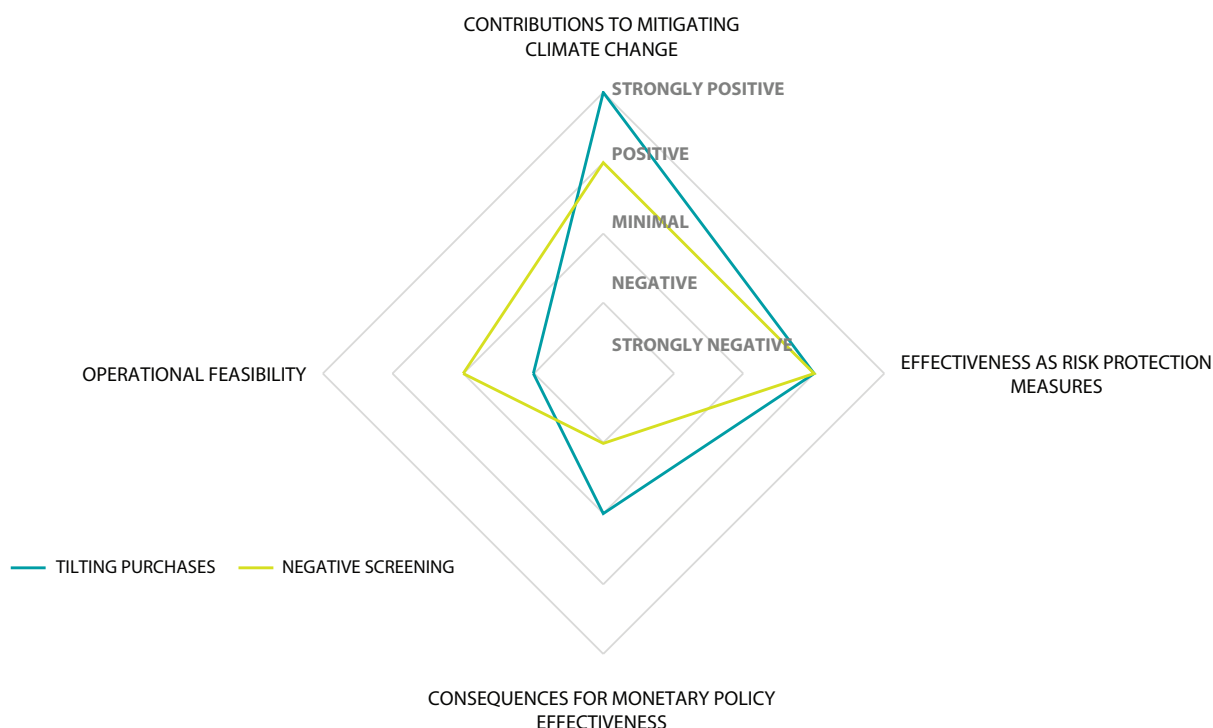
Central banks considering explicitly taking account of climate considerations in their asset purchases can draw insights from experience gained from the implementation of sustainable and responsible strategies in their non-policy portfolios.⁶

Two stylised approaches could be considered for adjusting asset purchases to climate-related risks: (i) introducing asset purchase tilting; and (ii) negative screening.

⁵ See, for example, Raynaud et al. (2020).

⁶ Work done in the NGFS on non-monetary policy portfolio strategies shows that: (i) thematic strategies via green bond purchases and best-in-class strategies applied to corporate issuers have proven useful in contributing to climate change mitigation; (ii) integrating Sustainable and Responsible Investment (SRI) indicators into the investment decision process tilts capital orientation towards assets that are less carbon-intensive, thus protecting the portfolio from some climate-related risks.

Figure 8. **Asset purchases. Comparison of climate-related measures**



A) Tilting purchases

Description of the measure

Asset purchases could, in principle, be tilted towards better-performing issuers or assets according to the climate-related criteria applied, although this would move away from traditional central bank interpretations of market neutrality. This can be done by using a climate, financial (including ratings) or hybrid metric. Tilting is likely to be more relevant for corporate than for sovereign assets.

Consequences for monetary policy effectiveness

Tilting may have less severe consequences for the available policy space than direct and broad exclusions resulting from negative screening. If tilting properly captured climate-related risks and were applied consistently across all eligible corporate issuers or assets, the measure could be expected to have only a limited impact on monetary policy transmission.

Tilting may be less susceptible to legal challenge than negative screening. This clearly depends on the actual design of the approach. More generally, if tilting were implemented in a manner that resulted in a large set of issuers being systematically excluded from purchases, the measure could have adverse impacts on market neutrality and even monetary policy transmission, particularly in times of market stress. This latter risk might be most marked in regions where economic activity is relatively more dependent on the sectors most affected. It would therefore be important to design tilting measures so that they take into account individual companies' performance and, ideally and to the extent practicable, their future decarbonisation plans.

Contributions to mitigating climate change

Tilting assets purchases could, in principle, be effective in contributing to climate-related risk mitigation. Depending on how it is designed in detail, the measure could reduce central bank financing of issuers that are highly carbon-intensive and/or incentivise eligible issuers to consider and reduce their climate risk footprint, particularly where corporate asset purchases take place in primary

markets. The measure could, in principle, be designed or calibrated to also reduce climate-related risks for central banks' balance sheets, as well as to support a shift in financing towards low-carbon issuers and assets. Tilting over time should lead the composition of asset holdings to gradually shift towards lower-carbon issuers, assets and sectors.

In the short term, this measure would principally have more of a signalling effect. It could serve to increase demand for low-carbon assets, helping to ease access to market financing for firms that are transforming their business models and operations to shield them from adverse transition risk.

Effectiveness as risk protection measures

Tilting is a relatively sophisticated way to reduce climate-related risks. It would likely imply taking climate-related risks as well as financial risks metrics into account. The risk efficiency of the measure would largely depend on the ability of central banks to properly capture an issuer or asset's carbon intensity and/or climate-related risk exposure.

Decarbonising asset purchases may also increase risk protection by reducing a central bank's exposure to the assets that are most at risk of being stranded, albeit at some cost in terms of a loss in standard credit risk diversification. The further behind issuers are in terms of adapting their business to climate change, the more stringent the impact on the purchasable universe could be.

Operational feasibility

Guiding actual purchases using climate-related risk metrics would likely be a source of additional operational complexity. Central bank asset purchases typically have to comply with predefined and largely public rules. Adding climate-related factors to these rules may have a bearing on central banks' scope to engage in agile trading. The degree of operational complexity would depend on the metrics and methodologies chosen.

In their purchases according to predefined rules, central banks may employ some level of discretion when they choose between comparable eligible assets in their daily transactions. These discretionary elements of day-to-day investment decisions are typically not public, for sound market functioning reasons. Asset purchase

investment decisions are typically less transparent at an individual security level than decisions related to pledged collateral which rests on the principle of ex ante clarification. Central banks are unlikely to be in a position to make their methodologies entirely public.

Central banks should approach tilting in the knowledge that their action will likely be standard-setting.

This action can positively influence markets through signalling. In designing tilting methodologies, central banks should leverage, to the largest extent possible, robust and commonly agreed metrics and references (taxonomies). This would prevent abrupt shifts in the risk perception of those issuers most likely to be affected. More generally, clear communication and allowing sufficient time for market participants to adjust, may serve to minimise any concomitant market disruption.

B) Negative screening

Description of the measure

Climate-related risk criteria can be used to screen and exclude some assets, issuers or sectors from purchases. Negative screening can be implemented at the inception of purchases, or applied to new net asset purchases, and/or when reinvesting maturing bonds. Depending on its calibration, the effect of screening may vary considerably. Negative screening can be calibrated so that very few or no actual exclusions are made initially. In this case, issuers are incentivised to remain compliant with screening rules to avoid being excluded in the future.

Consequences for monetary policy effectiveness

The loss of policy space would depend on the relative importance of the excluded sectors, issuers or assets in the economy. Direct exclusion of some sectors or issuers from asset purchases could reduce the effective monetary policy space. A priori, the more stringent the screening, the greater the loss of potential policy space.

By construction, negative screening would not be compatible with the willingness to homogeneously distribute liquidity across economic sectors. That said, although the stimulus to the excluded sectors or issuers would be reduced, it would not be entirely eliminated, as those sectors would continue to benefit from portfolio rebalancing effects.

Contributions to mitigating climate change

Exclusion resulting from negative screening would likely have more direct and larger impacts than tilting. It would directly curtail central bank funding of high carbon issuers or assets. Depending on market circumstances, the loss of eligibility may also impact negatively on other sources of financing for these issuers.

That said, depending on the climate-related metrics and the stringency of the scheme, negative screening applied to asset purchases faces the same problems as when it is applied to collateral: it may negatively influence transition efforts by carbon-intensive issuers, depending on the screening criteria.

Being prominent and authoritative market participants, central banks would need to be mindful that negatively screening some issuers could be seen as a benchmark or good practice by other participants, while current climate-related data and risks metrics are not yet fully stabilised and standardised.

Moreover, a central bank's decision to use negative screening in monetary policy asset purchases would likely come under intense public scrutiny and would need to be well justified if any legal and reputation challenges are to be avoided.

Effectiveness as risk protection measures

Negative screening lowers a central bank's exposure to climate-related financial tail risks more than tilting.

Nevertheless, the reduction in risk would vary greatly in magnitude and scope with the screening approach and the specific climate-related risk criteria on which it would rest.

That said, negative screening might not be the most efficient way to reduce climate-related risks. Negative screening may, in some instances, expose central banks to trade-offs between investing based on climate-related criteria and standard credit risk considerations. Moreover, it would improve the central bank's risk profile only to the extent that climate-related risk mitigation offsets the lower standard risk diversification. However, unlike in the case of commercial banks, diversification of risks is not the primary concern in the design of asset purchase programmes.

Operational feasibility

Screening assets or issuers in asset purchase portfolios requires a definition of climate-related risk criteria and thresholds. A broad range of options could be considered, such as norms, geographical locations, economic sectors and carbon metrics. To ease its design and implementation, negative screening could be based on pre-established and widely used climate standards or norms.

While so-called "high stake" economic activities are rather well-identified, justifying negative screening would require an objective approach, given the current lack of harmonised standards. If screening were conducted at the issuer or asset level, the need for granular data could be relatively substantial.

Box 6

Case study. The Riksbank's norms-based negative screening and enhanced disclosure of carbon data

On 25 November 2020, the Riksbank decided to apply norms-based negative screening to its purchases of corporate bonds issued by non-financial companies. Effective from January 2021, the Riksbank may exclude bonds from issuers that do not comply with universal global standards and norms for sustainability. The principles in the UN Global Compact represent one example of standards and norms that the Riksbank applies in this context.

The Riksbank must ensure that the conduct of its monetary policy operations is efficient and that the Riksbank is economical with public finances. It is therefore expected to manage the risks that arise from its operations, in this case the purchase of corporate bonds, including risks to the Riksbank's financial position. Sustainability considerations can form part of the Riksbank's general risk assessment in relation to its purchases of corporate bonds. Norms-based negative screening will form part of the risk assessment on the premise that companies in breach of universal norms-based principles are riskier compared with other companies. This approach also allows the Riksbank to manage public funds in a way that is in line with the Swedish state's core values. Sustainability considerations complement existing eligibility criteria already applied to the programme, such as the minimum credit rating criterion.

Sustainability considerations and negative screening will apply without compromising on the monetary policy aim adopted for the asset purchase programme. Any decision on exclusions will be subject to careful monetary policy and market functioning considerations. The Riksbank will follow the principle of market neutrality within the eligible universe that meets sustainability-related risk criteria.

The Riksbank makes sustainability assessments on its own, but also use sustainability data produced by an external supplier as inputs in its own assessments.

In addition to using norms-based negative screening when purchasing corporate bonds, the Riksbank also intends to measure and report on the carbon footprint made by its corporate bond portfolio. This will enable the Riksbank to promote the reporting of climate factors in general and create incentives for financial institutions such as banks and asset managers to disclose the carbon footprint of their assets and investments. The increased demand for better disclosure by financial institutions may in turn create incentives for companies and other organisations to measure and disclose their GHG emissions.

Annex 2. Climate-related metrics

Currently, a variety of metrics exist to assess climate-related risks (of a given asset, issuer, portfolio or project) and are used by investors to calibrate or adjust their investments.

GHG emissions are a key part of all major climate-related transparency initiatives. Compared to other elements of relevance to climate change, the measurement and availability of information on GHG emissions by companies is relatively advanced. GHG emissions, in quantitative terms, are usually measured in CO₂ and CO₂ equivalents, respectively.⁷

As regards carbon accounting schemes, i.e. the systematic collection and quantification of GHG emissions, the standards established by the GHG Protocol market initiative⁸ are regarded as the most commonly used framework among private and public market participants for measuring their individual carbon footprints. Reporting practices under the GHG Protocol follow three categories for delineating and classifying different types of emissions:

- scope 1: direct GHG emissions (occurring from sources directly owned or controlled by a company/entity);
- scope 2: indirect GHG emissions from generation of purchased electricity consumed by the company (i.e. the emissions physically occur at the power generation facility);
- scope 3: other indirect GHG emissions (optional reporting category, allowing for the treatment of all other indirect emissions which are a consequence of the activities of the company, but occur from sources not controlled by the company, e.g. extraction and production of purchased materials; transportation of purchased fuels; etc.).

Scope 1 and scope 2 emissions reporting could offer a very first starting point from which to engage in further and more in-depth analyses.

While available metrics differ in their methodological details, they can be grouped into forward-looking and

backward-looking metrics. The metrics used most frequently in financial markets are backward-looking ones, given that they are relatively easy to measure, i.e. they capture a quantitative target.⁹ These may include the following:

- absolute greenhouse gas (GHG) emissions;
- relative GHG emissions (scaled by a relevant factor: sales, revenues, debt, GDP, population, etc.);
- climate scores (e.g. power generation mix, “sustainable share”/“carbon-intensive share”).

Backward-looking metrics of this kind may be not ideal in terms of projecting a future path for gradual alignment with climate-related targets for a given set of companies or assets, but unlike forward-looking metrics (e.g. 2°C alignment) they are easier to measure and compare. Hence, backward-looking metrics are more operationally feasible from a central bank’s point of view.

Depending on the climate-related metrics chosen, the exposure can be derived in absolute or relative terms:

- carbon footprint calculates the tonnes of GHG emissions per million euro invested. It expresses the amount of annual GHG emissions which can be allocated to the investor per million euro invested in a portfolio;
- carbon intensity expresses total GHG emissions relative to the total share of revenue attributed to an investor. It is expressed in tonnes of GHG emissions per million euro of revenue. Introducing revenue adjusts for company size and is therefore a measure of a portfolio’s carbon efficiency;
- WACI also calculates the carbon intensity of each portfolio company in relative terms and scales it based on its weight in the portfolio. This metric can be used for comparison with a benchmark, to define reduction targets and potential ways to decarbonise a portfolio, as well as for reporting purposes. This metric allows for portfolio decomposition and attribution analysis, though it is more sensitive to outliers and favours companies with

7 CO₂ equivalents estimate the global warming potential (GWP) of a given type and amount of GHG, using the functionally equivalent amount or concentration of carbon dioxide (CO₂) as the reference; defined in detail in the scientific methodologies used by the UN Intergovernmental Panel on Climate Change (IPCC).

8 A partnership between the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD); the GHG Protocol works with governments, industry associations, NGOs, businesses and other organisations.

9 Forward-looking metrics (e.g. 2°C alignment or physical risk exposure) are more difficult to measure and compare and usually less accessible.

higher pricing levels than their peers. The drawback of this metric is that it provides information on the exposure or impact of a portfolio at a specific point in time, usually based on the last reporting period's emissions and sales data, without including any forward-looking information.

The key concepts for the most common monitoring metrics are summarised in the Sustainable and Responsible Investment Guide published by NGFS in October 2019.¹⁰ While the guide is intended for use in portfolio management, it is also useful from a more general perspective.

¹⁰ See NGFS (2019c).

Annex 3. Coordinating climate-related adjustments to operational frameworks

Climate change is a global problem with diverse and far-reaching implications for monetary policy operations. Individual central banks are likely to find coordination beneficial, because sharing ideas and knowledge derived from each institution's analyses and assessments can lead to a better understanding of this type of risk. Additionally, it might be expected to provide some guidance on how best to adjust operational procedures to climate risks, if needed, as well as limit adverse spillovers. And to the extent that central banks wish to act to mitigate climate change, collective action is likely to be more effective than "going it alone", when necessary.

Coordination during the period of transition can be viewed as particularly beneficial. Central banks are key players not only in their domestic markets, but often in global markets as well. Material changes in operational frameworks, especially among reserve currency issuers, may have substantial cross-border effects. These potential spillovers to the global financial system bring attendant risks which must be carefully considered, and might provide a strong rationale for coordination, while the central banking community has a long track record of successful cooperation.

Benefits of coordination

The details of the frameworks that central banks use to meet their operational targets often differ notably across jurisdictions. But at their core, all frameworks deal with the central bank's transactions with the banking system, both in normal times and in crises, and with the prudent management of the central bank's own financial exposures to its many counterparties. It follows that in designing climate-related adjustments to their operational frameworks, central banks will address a similar set of issues, and so stand to benefit from at least some forms of cooperation and information sharing.

Adopting common standards for climate-related financial disclosures would ease the burden on central banks and financial institutions alike, and aid cooperation, as central banks rely both on internal and external risk assessments. Central banks may also find value in reaching broadly similar views on matters such as the haircuts required to achieve risk equivalence on climate-exposed asset classes.

Counterparty eligibility frameworks

The criteria determining whether an institution is eligible as a monetary policy counterparty differ across jurisdictions. There is nevertheless an opportunity to cooperate, in particular on the definition of climate-related disclosure requirements as part of the eligibility process. Reporting standards such as those proposed by the TCFD could be used as guidance. Central banks' coordination efforts would also benefit monetary policy counterparties, notably global institutions, as similar standards would lower the reporting burden.

Necessity of coordination

Asset prices

Changes to any aspect of central banks' operational frameworks that tend to favour sustainable assets, or disfavour carbon-intensive assets, have potential price effects: the "eligibility premium", as it is known, for assets that can be used to obtain central bank money through Lombard facilities; and "local supply" effects where investors lack close substitutes for assets the central bank purchases outright. The direct pecuniary impact that operations have on other agents may be amplified in undesirable ways when sustainable assets are already scarce or markets for them are underdeveloped. Spillovers could be large if a central bank were to make carbon-intensive assets ineligible, or impose unattractive terms on them, during a stress event, potentially amplifying price moves. Spillovers of a different variety are conceivable in cases where central bank operations induce new capital market issuance (as has been observed with certain corporate bond purchase programmes) by corporations located in other jurisdictions.

Collateral frameworks

The rules governing access to central bank money through standing facilities lies at the core of their emergency liquidity assistance function and the day-to-day implementation of monetary policy decisions. Their importance for core central bank functions means that changes in the rules

must be clearly and carefully communicated to banks and market participants. A premature narrowing of collateral frameworks, or poorly communicated changes, could present stability risks that spill across borders or jeopardise price stability objectives.

Whether they choose to enact changes in the near term or plan to wait, central banks will need to monitor how their counterparties respond to evolving rules. Where divergent treatment of climate-sensitive assets exists between jurisdictions, it is possible that collateral will be repositioned. Central banks that have moved ahead may find themselves with unexpectedly larger exposures to sustainable assets that are illiquid and costly to manage. Those who move more slowly may find that their exposures are tilted towards assets that are more at risk of stranding.

Foreign exchange operations

Central banks conduct several types of foreign exchange operations, such as swaps and repos, besides outright purchases and sales of foreign exchange. They carry out these operations for various purposes, such as foreign currency liquidity management, reserve management, international financial cooperation, and foreign exchange interventions. A few central banks also use the exchange rate as a tool to either directly or indirectly support their overall policy goals.

The central banks in this group hold a portfolio of safe and liquid foreign exchange instruments to satisfy policy objectives. While some central bank foreign asset portfolios have clear short to mid-term policy goals requiring stability and low risk levels, others may have more leeway to adopt a broader scope for sustainability. The need for central banks to coordinate and adopt common identification standards and definitions of green bonds would facilitate consistency with investment goals, risk tolerance and liquidity.

Limiting spillovers

Much of the potential for the adverse spillovers described above to manifest themselves can be mitigated through effective coordination that ensures that climate adaptation is well sequenced, clearly communicated, and which minimises the scope for counterparties to arbitrage different rules.

Takeaways

In summary, central banks can benefit from maintaining engagement with developing ideas in the operations space, including through participation with the NGFS. Closer cooperation is likely to be valuable amongst regional groups, and among central banks with similar operational frameworks (for example, those where standing facilities are routinely used in policy implementation). However, central banks should remain at liberty to move at a pace suited to their jurisdiction, while remaining mindful of the spillovers of their decisions, and learning lessons from the experience of early adopters.

Annex 4. Bibliography and overview of recent proposals

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