Network for Greening the Financial System

Technical Note

Greening Monetary Policy Operations:

Exploring Additional Options

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NGFS

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Foreword

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The accelerating impacts of climate change are reshaping the environment in which central banks operate. Climate-related hazards can damage property, disrupt supply chains, and slow down production, while climate policies reshape demand, drive innovation and affect firm profitability, which may give rise to prolonged relative price changes in the economy. The economic ramifications of extreme weather events and transition policies increasingly intersect with the time horizons of monetary policy, creating challenges for central banks in maintaining price/currency stability. This means that central banks will need to assess how climate-related shocks – often resembling large, unpredictable, and potentially persistent supply shocks – could complicate striking an effective balance between price stability and economic growth.

Since 2019, the NGFS has been exploring the impact of climate change on monetary policy. The launch of the Workstream on Monetary Policy in 2022 formalised this commitment, producing methodological studies and practical guidance on integrating climate considerations into monetary policy analysis and operations. This paper continues this effort by expanding current NGFS work on how central banks can adapt their monetary policy operations to manage climate-related exposures and support an orderly economic transition to low-carbon economies. Past NGFS work has focused mainly on measures that impact central bank assets, such as practical adjustments to monetary operations across credit, collateral, and asset purchase policies. However, some of these asset-side adjustments may be limited by their cyclical nature; and their relevance and effectiveness depend on structural factors such as a jurisdiction's monetary policy framework. In some cases, and where mandates permit, greening monetary operations involving changes in central banks' liabilities may therefore be worth investigating.

Different central banks have different mandates relating to climate change. The aim of this work is to support central banks where greening liability-side policies is consistent with their mandate and operating framework. While this may not be appropriate for all central banks, the role of the NGFS is to provide technical support to its members who are able, and wish to, incorporate climate-related considerations into their monetary operations. In this regard, this paper builds on past recommendations to provide a comprehensive framework for greening monetary operations. Considering climate-related factors for reserve requirements and short-term debt issuance, central banks can complement current practices on the asset side of their balance sheets. While implementing these measures may present challenging trade-offs, particularly when compared to most asset-side tools, they may be worth considering for central banks that have a mandate to support government-led climate initiatives and where liability-side monetary policy operations are significant.

Executive summary

The far-reaching implications of climate change can influence the design and implementation of monetary policy and consequently the conduct of monetary policy operations. Central banks can adjust their monetary policy operations to strengthen their protection against climate-related financial risks from natural hazards and transition policies, and subject to their mandates, also to support government-led climate change mitigation and adaptation strategies. Previous NGFS work has so far mainly focused on measures that impact central bank assets, such as adjusting collateral frameworks, tilting asset purchases towards less carbon-intensive issuers, and implementing climate-linked credit operations. However, the effectiveness of some of these asset-side adjustments may be limited by their cyclical nature; and their relevance also depends on structural factors such as a jurisdiction's monetary policy framework. In light of that, this paper expands current NGFS thinking by considering measures that focus on the liability side of central bank balance sheets. In addition, considering greater flexibility and/or longer planning horizons for selective asset-side measures complements the expanded scope of greening monetary policy operations.

A more holistic and inclusive approach to incorporating climate change considerations into monetary policy operations can help enhance their effectiveness over the monetary policy cycle. In particular, incorporating climate considerations in selective liability-driven measures can effectively complement current greening practices covering credit, collateral and asset purchase policies. For instance, in some jurisdictions, central banks rely on liquidity-absorbing measures to implement monetary policy. By adapting minimum reserve requirements and remuneration frameworks to incentivise green lending and deposits, and developing green monetary instruments backed by sustainable assets, central banks can foster persistent incentives for financial institutions to support climate objectives throughout the monetary policy cycle. Such incentives extend to the borrowing and saving behaviour of non-financial corporates and households. The paper also highlights methodologies to advance and enhance the impact of asset-side greening. These measures include longer-term targeted refinancing operations that channel liquidity to sustainable investments and expanding access to central bank liquidity support for non-bank financial institutions engaged in sustainable finance. Finally, the paper provides a conceptual framework and cost-benefit analysis of these additional policy instruments, and discusses operational, legal, and market challenges involved in their implementation, recognising that the applicability of these options depends on central banks remits to support broader government-led climate transition objectives.

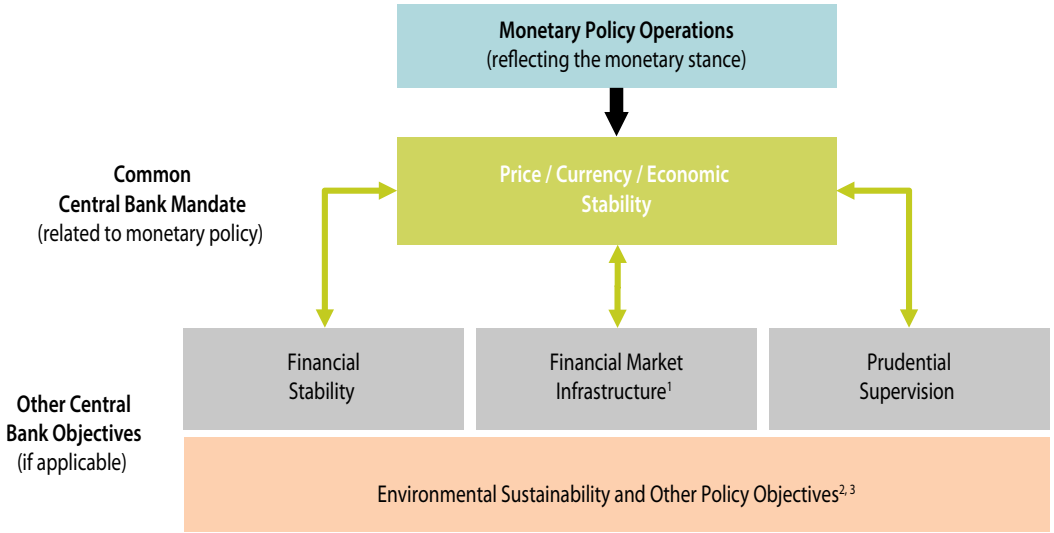
By extending greening to both assets and liabilities, and calibrating "tools" to local mandates and market conditions, central banks with relevant mandates can play a supportive role in reducing climate-related financial risks across the wider system and accelerating the allocation of capital in support of the climate transition, without compromising their primary objectives of price and currency stability.

1. Introduction

While governments and legislators are responsible for creating the conditions conducive to enhancing climate resilience and creating an orderly transition to a low-carbon economy, central banks can play a supportive role within their mandates. Climate change presents significant risks to real economic activity, monetary policy transmission, and financial stability. Central banks will therefore need to consider the impact of climate-related financial risks while some have also been tasked with supporting climate adaptation and mitigation (Figure 1). Globally, many central banks have a mandate, either directly or indirectly, to help achieve their government's economic policy objectives, which will often include addressing climate change. The economic implications of climate change increasingly fall within time horizons relevant to monetary policy and influence how central banks assess their monetary stance and conduct monetary policy operations. By strategically adjusting their monetary policy operations, central banks can not only shield themselves from climate-related financial risks ("climate risk protection") but they could also contribute to a more effective allocation of capital to funding towards low-carbon investment opportunities, in line with their government's transition pathways ("climate change mitigation") and enhance socio-economic resilience ("climate change adaptation").[1]

There is broad consensus that climate change – and the policies addressing it – affect macroeconomic outcomes and the setting of monetary policy. Physical risks – such as extreme weather events[2] – can directly damage assets, disrupt business operations, and increase insurance claims, while transition risks – arising from shifts toward a low-carbon economy – can lead to large and prolonged changes in relative prices as well as higher loan defaults and market volatility (NGFS 2024b, 2024c). These impacts may, in turn, cause significant policy trade-offs and could hinder the ability of central banks to (1) effectively deliver on their primary mandate, such as price and currency stability,

Figure 1 **Monetary policy operations and central bank mandates**



Note: 1/ payment and settlement systems and intermediaries; 2/ including consumer protection, AML/CFT supervision; 3/ for instance, the secondary mandate of the European Central Bank (ECB) and the Eurosystem also includes support for European Union policies.
Source: Authors.

1 This paper considers the use of monetary policy operations in pursuit of central banks' price or currency stability mandates. Therefore, it excludes climate change-related considerations affecting other goals of some central banks, such as financial stability (Figure 1). Climate adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic change and its effects, aimed at reducing vulnerability and building resilience (UNFCCC, 2025; NGFS, 2025a). Climate mitigation refers to actions that reduce the rate of climate change by limiting greenhouse gas (GHG) emissions or enhancing carbon sinks (IPCC, 2022).

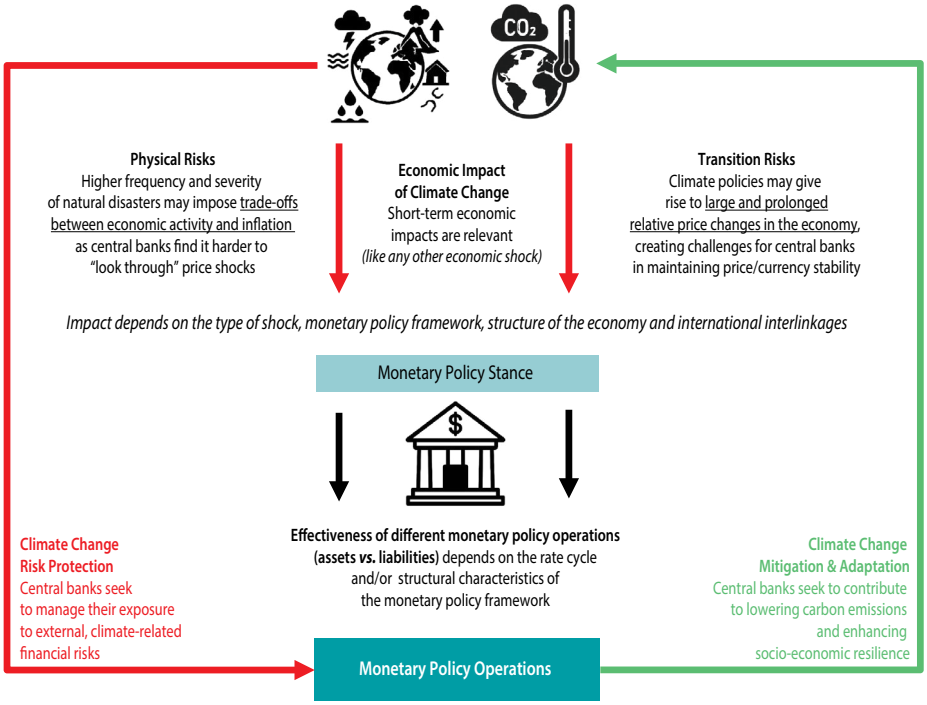
2 This includes the implications of gradual environmental changes, such as the progressive increase in temperatures and rising sea levels, which do not only exacerbate the frequency and severity of natural disasters, but also reduce labor productivity and degrade the reliability of essential infrastructure.

and (2) maintain effective monetary policy transmission (NGFS, 2020).[3] Hence, a growing number of central banks (and financial regulators alike) have started monitoring climate risks and incorporating these considerations in their monetary policy frameworks and financial stability decisions (Grippa *et al.*, 2019).

The influence of climate-related financial shocks on monetary policy requires central banks to review (and amend as necessary) existing operational frameworks. The short-term impacts of climate change are relevant for determining the monetary policy stance (Figure 2); they could arise from physical risks (i.e., higher frequency and severity of natural disasters and progressive temperature increase, imposing trade-offs between economic activity and inflation due to negative supply shocks) and transition risks (i.e., large relative prices changes that create trade-offs not only between growth and price/currency stability but also financial stability challenges due to asset re-pricing and deteriorating credit quality).

The monetary policy stance will, in turn, have a bearing on the type (and scale) of monetary policy operations that central banks conduct. With respect to the asset side of a central bank's balance sheet, monetary policy operations typically involve liquidity management through collateralised lending to eligible financial institutions through standing credit facilities ("credit operations") and/or outright asset purchases.[4] On the liability side, some central banks manage system-wide liquidity and money creation by requiring banks to hold a minimum share of their liabilities in the form of central bank reserves (such as minimum reserve requirements for short-term liabilities). Asset purchases (including buy-backs) and lending operations generally result in the creation of central bank reserves and/or other liabilities. Conversely, central banks offer access to liquidity management facilities (e.g., overnight deposits) and conduct open market operations, including through securities lending/reverse repo transactions, to absorb excess (system-wide) reserves up to a desired target level (and above some liquidity buffer for settlement purposes). For this purpose, they can issue certificates of deposit or short-term debt securities (i.e., in the form of monetary bills).

Figure 2 **Central bank objectives in connection with climate change**



Note: Climate-related financial risks for central banks do not only stem from insufficient climate change adaptation but also climate change mitigation, such as relative price changes from carbon pricing affecting the valuation of assets held in the reserves portfolio.
Sources: NGFS (2021, 2024b) and authors.

3 Even for central banks whose mandate is focused on currency stability (especially in the case of fixed exchange rate regimes), climate risks can jeopardise foreign exchange reserves supporting the monetary base cover due to an adverse shock to the external balance (e.g., a collapse of export revenues of poorly diversified hydro-carbon economies due to effective and comprehensive global carbon pricing or large natural catastrophes causing significant damage to the tourism sector of small island economies with limited fiscal buffers).

4 Note that fine-tuning open market operations involves either side of the central bank balance sheet depending on whether the central bank absorbs or injects liquidity, which often occurs concurrently in monetary policy regimes with a corridor interest rate system.

Central banks can adapt monetary policy operations in support of government-led climate mitigation and adaptation strategies, provided these actions are within their legal mandate. This approach requires balancing such objectives with market neutrality principles and their medium-term objective of price/currency stability. The central bank's mandate would ultimately determine the scope of implementation – especially as such actions can challenge the principle of market neutrality.[5] More importantly, these efforts must be pursued without compromising the central bank's medium-term objective of price/currency stability, which remains the primary goal.

Current NGFS work on greening operations is largely focused on measures affecting central bank assets (NGFS, 2021 and 2024b, Box 1). Considering financial risk protection of a central bank's balance sheet and the implications of asset purchases and credit operations is particularly relevant when tight liquidity conditions make access to central bank money more valuable. However, the composition of central bank assets is inherently cyclical and the effectiveness of asset-based measures can vary over time. For example, when central banks need to manage excess reserves (as a result of balance sheet expansion due to asset purchases), the effectiveness of asset side-driven measures like climate-related conditionality of collateral policies diminishes. In addition, climate-sensitive monetary operations affecting only central bank assets are likely to be less relevant for greening monetary policy operations when central banks employ liabilities-driven measures to manage system-wide excess reserves. These include material reserve requirements and/or the issuance of short-term debt securities and certificates of deposit.

This paper aims to widen existing thinking by recognising that central banks, mindful of their policy objective, can also change the composition and treatment of their liabilities in a way that is consistent with their mandate and operating framework.[6] A comprehensive approach that considers both sides of central bank balance sheets in a structurally robust way can engender a more persistent, inclusive and reliable effect of greening monetary policy across a wider range of financial conditions. Different asset- and liability-side instruments may matter at different parts of the monetary policy cycle. For example, when a central bank unwinds its asset purchase programs during times of monetary tightening, then any "tilting" of these asset holdings becomes less impactful.[7] Similarly, if such unwinding takes time and perpetuates system-wide excess reserves, banks' demand for liquidity from central banks remains low, diminishing the effectiveness of greening collateral policies. In these cases, monetary policy operations involving changes in central banks' liabilities may be more useful. For example, as reserves in the system fall, any minimum reserve requirements become more binding. In addition, there could be structural reasons why asset- or liability-side measures are more important in different jurisdictions depending on the characteristics of the respective monetary policy framework. For instance, central banks with structural excess reserves may be better placed to adopt greening measures that are linked to the liabilities side of their balance sheets. However, in this case, the objective of protecting the central bank balance sheet against climate-related risks becomes less relevant by definition. This means that undertaking such measures would require a careful assessment of whether they fall within the central bank mandates. While this approach may not be suitable for every central bank and may involve difficult trade-offs (especially when compared to most asset-side tools), it could be particularly useful for those central banks who can support government-led climate initiatives within their mandate.

Relatedly, the paper also explores whether existing asset-side measures that can help integrate climate change considerations over longer time horizons and enhance their impact, building on existing thinking.[8] Taking a proactive and persistent approach would involve

5 Especially if adjustments to central banks' organic laws/statutes affect the effectiveness of liquidity management measures.

6 In the previous paper (NGFS, 2024b), this aspect was highlighted as a potential area of extension: "central banks may want to consider how to incorporate climate considerations into tools that focus on the liability side of central banks' balance sheet. This could include the role of linking reserve requirements to climate factors, or central banks issuing 'green bills'. This could be particularly relevant for central banks that operate in an environment of a structural liquidity surplus […] (p. 26)."

7 Tilting means modifying the composition of asset purchases without changing the overall volume or policy stance of quantitative easing. It involves re-weighting purchases based on climate criteria – for instance, by assigning higher purchase weights or better pricing to bonds issued by firms with lower carbon intensity, stronger decarbonisation targets, or higher-quality climate disclosures, relative to a climate-neutral benchmark allocation.

8 The previous paper (NGFS, 2024b) also stressed that "further work may be needed to understand how to best integrate climate considerations into monetary policy operations during periods when interest rates are above the [zero lower bound]. […] the NGFS may hence want to put more weight on other, more structural aspects of monetary policy operational frameworks, such as collateral policies or the composition of permanent monetary policy portfolios (p. 27)."

incorporating longer-term climate considerations into additional asset-side measures and potentially widening the scope of liquidity support to non-bank financial institutions in support of climate/sustainability initiatives, including in the context of monetary-fiscal coordination.

However, the paper does not discuss the extent to which climate-related factors should be considered when determining the appropriate monetary stance and its impact on the scale and nature of monetary policy operations. Climate change-related factors are already starting to shape the near-term macroeconomic outlook through energy prices as well as extreme weather events affecting both the supply and demand sides of the economy. The determination of the appropriate monetary policy stance in the face of these macroeconomic impacts is largely separate from the appropriate design of monetary policy operations and, therefore, outside of the scope of the paper.

Overall, the paper complements current NGFS thinking on greening monetary operations. Its aim is to assist central banks in considering the full range of all available policy measures to achieve their objectives and how they could include climate aspects in their operational frameworks if required by their mandates. It primarily focuses on liability-side tools, but also includes further options that do not neatly fit into this balance sheet-based taxonomy and additional considerations around structural elements of credit operations . As such, it forms a natural extension of the NGFS's earlier work on this topic. Consistent with previous NGFS analysis, this analysis features relevant case studies, highlighting key benefits, current challenges, and potential solutions. However, given that potential liability-side tools have hardly been used thus far, the paper cannot deliver concrete evidence of their effectiveness.

The paper is organised as follows. Section 2 presents the rationale for extending the current NGFS thinking on monetary policy operations. Section 3 discusses additional options for greening central bank operations, with a focus on liabilities and longer-term lending operations, together with relevant examples. Section 4 assesses the practical challenges involved and ways to address them. Finally, Section 5 concludes.

Box 1

Summary of Previous NGFS Work on Greening Monetary Operations

In its previous work on monetary policy operations, the NGFS focused on how central banks can mitigate climate-related financial risks to the asset side of their balance sheet as well as ways in which these operations can support the transition towards a low-carbon economy. In particular, central banks could adjust the terms of their lending operations as well as their asset purchase programs to consider climate-related factors (NGFS, 2021). Possible changes to lending operations (such as standing liquidity facilities and other credit operations) included restricting access by counterparties, reducing interest rates that central banks charge (e.g., conditional on climate-related lending), or amending collateral requirements in terms of eligibility and valuation haircuts. Changes to asset purchases included tilting asset purchases towards "greener" issuers and less carbon-intensive bonds or screening securities based on climate-related factors, which helps protect the central bank balance sheet against financial risks from climate change while creating pricing incentives for sustainable finance.

In a stocktake, the NGFS (2024b) showed that several central banks had successfully overcome many of the challenges in greening the asset side of their monetary operations. Some of the developed approaches are now actively used across both advanced and emerging market economies. The NGFS reviewed eight prominent case studies where central banks had tilted asset purchases, adjusted collateral requirements, or introduced refinancing programs that were tied to commercial banks' climate-related lending. In most cases, central banks had adopted these measures to support the climate transition (rather than as protection against climate-related financial risks).

2. Scope for greening monetary policy operations

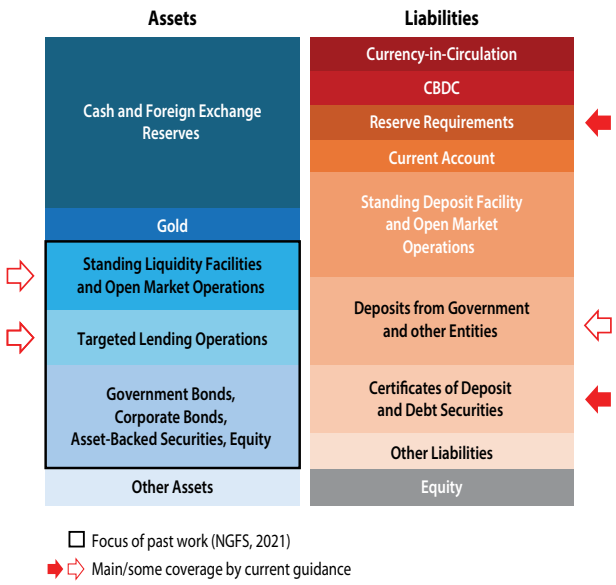
Although adapting monetary policy operations can also play an important role in supporting the climate transition, central banks' ability to do so is circumscribed by their mandate. Managing material financial risks from climate change on their own balance sheet is a core responsibility of every central bank, which is particularly relevant for asset-side measures (covered by the current NGFS thinking). However, whether central banks should consider modifying their stance to support the transition towards a low-carbon economy and/or help enhance socio-economic resilience via climate change adaptation which applies mostly to additional (liability-side) measures proposed in this paper, depends on their mandate. Given the diversity of existing legal frameworks, the scope of climate-related measures varies across jurisdictions. The primary objective of most central banks is to ensure low and stable inflation (or exchange rate), which is considered essential for supporting economic growth and job creation (Figure 1). In this context, any intervention by central banks to address climate change under their primary objective would require an assessment of how and to what extent physical and transition risks could affect their capacity to meet their primary mandate (NGFS, 2025b, 2024a and 2024d).[9] Some central banks also have an explicit mandate to support the transition to a low-carbon economy, which, in most cases, should not prejudice their primary objective of price/currency stability.[10] Central banks have increasingly developed expertise and analytical "tools" focused on better assessing climate-related financial risks, including in their efforts to climate-proof the implementation of other objectives within their mandates, such as financial sector regulation and supervision. Indeed, the more robust the underlying economic framework, the easier the accountability of how central banks incorporate the implications of climate change in their policy decisions.

Integrating climate-related considerations into central bank operations can also challenge the principle of market neutrality and distort market outcomes. The principle of market neutrality, i.e., treating all assets the same based on available market prices, is often seen as a way to minimise the impact of central bank interventions on the competitive processes of market price discovery. Central banks can use their signalling power (and marginal price incentives) to steer financial flows towards sustainable activities, but this may raise concerns about their independence and adherence to market neutrality. For instance, selectively favouring specific sectors or asset classes could be perceived as distorting the level playing field, potentially leading to allocative inefficiencies and challenging the credibility of the central bank's operational framework. By contrast, efforts to preserve market neutrality can sometimes conflict with the need to act on climate-related financial risks, including via targeted operations, given that current asset prices do not fully reflect climate-related financial risks (Eren *et al.*, 2022; Campiglio *et al.*, 2019; NGFS, 2019). Hence, central banks need to strike a balance between addressing climate risks and ensuring that their actions do not distort market prices.

9 Strictly speaking, it is more accurate to refer to uncertainties rather than risks (Broeders and Schlooz, 2021). In the context of climate change, uncertainty arises from the complex and unknown characteristics of its development and impact, including nonlinearities, tipping points, feedback loops, and interactions. Similarly, significant uncertainty exists regarding the timing, scale, and effects of the policy measures required to achieve a climate-neutral economy, as well as the influence of these measures on technological progress and shifts in consumer and investor preferences. Risks, by contrast, are measurable in terms of potential outcomes and probabilities ("known-knowns").

10 Based on research by Dikau and Volz (2021) as well as Crofils *et al.* (2024) only a few central banks, such as People's Bank of China (PBoC) and Bank Sentral Republik Indonesia, have an explicit mandate or climate objectives directly in their mandate or related legislation. For instance, the PBoC is explicitly tasked with supporting "green finance," and its regulatory and monetary policy framework includes climate risk and sustainable investment considerations as part of its official responsibilities. More than one-third of all central banks have an indirect sustainability mandate by being required to support their government's broader economic policy goals, which often include climate and sustainability targets. For example, the European Central Bank (ECB) and all national central banks of the Eurosystem are required to support the European Union's climate goals through its general economic policy ("… support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union."). Similarly, the UK government's annual monetary policy remit letters to the Bank of England specify that the Bank's objectives shall be to maintain price stability as well as support the economic policy of His Majesty's Government, including to "deliver long-term growth and accelerate the transition to a climate resilient, nature positive and net zero economy (HM Treasury, 2024)". See also Matos Rosa (2025).

Figure 3 **Affected areas of the central bank balance sheet (stylised)**



Note: This representation of a central bank balance sheet is closer to that of a central bank with a less flexible monetary policy framework where high foreign exchange (FX) reserves and central bank reserves/ open market operations dominate assets and liabilities, respectively.
Source: Authors.

Balancing climate change impacts with market neutrality involves factoring climate change considerations into market mechanisms without unduly distorting them. The market neutrality principle may not be appropriate if markets fail to accurately price climate-related risk factors due to externalities, therefore perpetuating inefficiencies and preventing resources from being allocated to more sustainable solutions.[11] Addressing current mispricing by introducing market efficiency as a guiding principle would need to be thoroughly evaluated against the limitations stipulated by a central bank's mandate (Schnabel, 2021).

Although the scope of climate-related framework adjustments depends on each central bank's mandate, most existing efforts have focused on climate-related measures which affect the asset side of balance sheets – such as asset purchases related to monetary policy operations (such as government bonds and other liquid debt securities) and credit operations (collateral eligibility criteria and valuation haircuts) – and often with a view to guard against climate-related financial risks to the central bank balance sheet (as a matter of comprehensive risk governance). However, many of these asset-side measures are inherently cyclical (depending on the monetary stance)[12] and are less relevant in monetary policy regimes with structural excess reserves (Section 3). In this context, it warrants exploring the potential use of measures whose impact is more persistent in a comprehensive approach that includes both sides of the central bank balance sheet. The liability side can also be relevant when central banks proactively manage reserve demand. In such cases, liquidity-absorbing measures can help strengthen incentives for climate-smart behaviours among financial and non-financial institutions alike (Figure 3).

Table 1 **Extending the scope for greening monetary operations**

Area	Examples
Assets *Persistence of climate considerations: structurally integrate climate factors*	• Greening (long-term) **credit operations** by adjusting pricing or counterparty eligibility
	• Greening **collateral frameworks** through valuation haircut adjustments or screening of collateral
	• Greening **asset purchases** (including reserves management) through screening or tilting
	• Dedicated **liquidity facilities** for non-bank financial institutions (NBFIs) involved in sustainable/climate projects
	• **Monetary-fiscal coordination** (e.g., providing (emergency) funding for climate-focused public sector investment initiatives)
Liabilities *Effectiveness of climate considerations: manage liquidity surplus with climate considerations*	• Green **reserve requirements** (through differential reimbursement or tiering of the reserve account) depending on climate-related investment/lending
	• Issuing **green short-term debt securities** (monetary bills) and/or certificates of deposit
	• Offer **central bank accounts** to NBFIs involved in sustainable/climate projects

Source: Authors.

11 When climate change is an externality that cannot be fully priced by the market, a strict interpretation of the concept of market neutrality could result in an implicit bias in favour of carbon-intensive industries and firms.

12 For instance, higher system-wide liquidity during times of monetary easing reduces the relative importance of credit operations, and, thus, any climate-related "conditionality" central banks might impose in the effort of greening monetary operations.

Table 1 summarises the ways central banks can amend their monetary policy operations on both the asset and liability sides of the balance sheet with a view to creating a more persistent effect of climate incentives based on a wider range of measures. On the asset side, they could incorporate climate change-related criteria in asset purchase programs, create targeted long-term credit operations (based on climate criteria), and develop dedicated liquidity facilities supporting sustainable/climate projects, even if this might involve non-bank financial counterparties and backstop government climate-focused public sector investment initiatives. On the liability side, central banks could link reserve requirements to climate-related factors or issue "green monetary bills" in managing system-wide liquidity.

In addition to concerns about market neutrality, a comprehensive approach to greening monetary operations must carefully balance potential drawbacks and structural constraints. It is important to evaluate the potential effectiveness of both asset- and liability-side measures in relation to the perceived difficulty of implementation, taking into account the implications of the existing monetary framework and legal requirements. These implications may include increased operational complexity, potential adverse effects on monetary policy transmission, higher compliance burdens, and increased data and verification needs. Following the exploration of various options for greening monetary operations, the paper will analyse these considerations in a detailed assessment of the trade-off between climate impact and operational feasibility, while excluding the impact of these options on risk mitigation.

3. Extending current NGFS thinking

3.1 Central bank liabilities: new measures

3.1.1 Green minimum/statutory reserve requirements and deposits

General considerations

Some central banks use reserve requirements as a key policy tool to manage liquidity, facilitate monetary policy transmission, and safeguard financial stability by ensuring a minimum amount of bank borrowing is backed by reserves (Glocker and Towbin, 2012; Hardy, 1997). Central banks directly influence money supply if banks are required to maintain a certain percentage of their short-term liabilities as reserves. Minimum reserve requirements can serve several purposes depending on the characteristics of the monetary policy operational framework. Typically, required reserves create consistent demand for central bank money and help stabilise short-term money market interest rates, facilitating the transmission of the monetary policy stance. Increasing reserve requirements decreases system-wide liquidity and curbs excessive lending. In contrast, decreasing reserve requirements boosts system-wide liquidity. Reserve requirements were originally motivated by prudential regulation, protecting commercial banks against liquidity shocks and adding confidence to the use of private money. Material reserve requirements fulfil a prudential function by ensuring that banks maintain adequate liquid assets to meet withdrawal demands, thereby reducing the risk of bank runs during periods of financial strain or capital outflows., in particular in emerging market and developing economies (EMDEs).[13]

One of the monetary policy objectives of reserve requirements is absorbing excess reserves. Central bank reserves can be categorised as either required reserves or reserves held over the requirement amount, which are referred to as excess reserves. Minimum reserve requirements help central banks manage the level of system-wide excess reserves to stabilise short-term market interest rates in alignment with the policy rate. The remuneration rate of excess reserves as well as their volume affects the marginal effective policy rate. Excess reserves are also an attractive way to hold liquidity due to their status as high-quality liquid assets (HQLA), relevant to the fulfilment of certain prudential requirements.[14]

While their role as a monetary policy tool has diminished in many advanced economies, reserve requirements remain relevant for many central banks in EMDEs. In countries with high system-wide liquidity, reserve requirements (and the remuneration of excess reserves) are instrumental in stabilising short-term interest rates as a key element in monetary policy implementation. However, the (active) use of reserve requirements has declined, especially in advanced economies due to the availability of alternative "tools" like open market operations. Therefore, the role of required reserves and the compensation for excess reserves can be different across jurisdictions, depending on the respective monetary policy framework.

The scope for effectively greening reserve requirements will depend on their primary purpose in the respective monetary policy operational framework. Since required reserves represent a pre-determined share of commercial bank deposits, they have a significant leverage effect on profitability, and, thus, could create powerful financial incentives, especially in countries with high reserve requirements due to large system-wide liquidity. Lowering reserve requirements, contingent on an identifiable climate effort, could positively influence banks' sustainable activities and signal a proactive climate policy stance in terms of size and pricing. However, reducing reserve requirements for sustainable activities-related short-term funding would reduce commercial banks' resilience to liquidity shocks. Climate-sensitive reserve requirements introduce the risk that temporary poor "green performance" by commercial banks could lead to tighter reserve requirements across the system; this would be particularly problematic if it coincided with general funding pressures during times

13 However, the prudential purpose of reserve requirements has been increasingly replaced by other measures of central banks, such as macroprudential policies or banking supervision.

14 In general, assets are considered to be HQLA if they can be easily and immediately converted into cash at little or no loss of value. HQLA primarily impact the Liquidity Coverage Ratio (LCR) as part of banks' "counterbalancing capacity", but they also influence other prudential liquidity risk management metrics, such as the Net Stable Funding Ratio (NSFR), and broader liquidity stress testing frameworks.

of stress.[15] These risks do not necessarily affect the central bank itself – but they could have implications for the stability of the wider financial system.

Green funding and lending programmes could offer a useful starting point for integrating sustainability objectives in reserve requirements. Some commercial banks have already started offering so-called "green deposits" as earmarked funding for climate-friendly projects, similar to the use-of-proceeds mechanism of green bonds (Box 2), which could inform the design and implementation of a differentiated treatment in reserve requirements. For example, central banks could exclude these deposits from the calculation of reserve requirements (see below). However, without stricter criteria, regulatory acceptance might be challenging given the lack of ring-fencing for green deposits as a result of a portfolio-based approach to assessing their sustainability impact. While customer demand for green deposits could lower funding cost for climate-friendly activities, any expansion of the deposit base (thanks to the attractiveness of achieving "green impact") would raise commercial banks' marginal opportunity cost of holding higher central bank reserves.

Box 2

Green Deposits: Concept, Frameworks and Country Examples

A green deposit is a type of financial deposit that is specifically earmarked to fund a bank's environmentally sustainable projects or initiatives. Since green deposits operate similarly to green bonds, their governing frameworks are generally aligned with international standards, such as the ICMA (2025) *Green Bond Principles*, and regional/national sustainability taxonomies, including the application of the use-of-proceeds principle. The use-of-proceeds principle is a key concept in green finance, ensuring that funds raised through green bonds are allocated solely to eligible green projects that provide clear environmental benefits. Issuers must document and monitor how the proceeds are used, typically through dedicated accounts or internal systems, to maintain transparency and prevent mixing with non-green funds. This principle also applies (indirectly) to green deposits, where banks must show that deposited funds support eligible green projects. However, unlike green bonds, banks often use a portfolio-based approach for green deposits, matching the total volume of deposits with an equivalent amount of green assets or projects in their lending portfolio rather than tracking specific proceeds to individual projects.

A well-structured green deposit programme is defined by a robust, transparent, and clearly defined assessment framework, which comprises the following characteristics:

- *Eligibility*: comprehensive evaluation and selection process of green investments/projects based on their environmental impact and compliance with sustainability standards and clear investment categories, such as renewable energy, energy-efficient buildings, and low-emission transport in addition, distinguishing acceptable projects from those that do not meet sustainability standards ensures the integrity of the green portfolio.
- *Implementation and monitoring*: regular assessments of fund allocation and project through continuous evaluation enhance accountability and effectiveness.
- *Reporting*: regular updates to depositors through transparent reporting practices fosters trust and reinforces the credibility of the green deposit initiative.

The green deposit approach elevates the concept of the traditional deposit function, transforming it into a mechanism for impact-driven finance. Given the significant financial resources needed to support the green transition in the upcoming years, leveraging deposit flows for sustainable investments could be a crucial source of funding. The increasing popularity of green deposits is part of a larger trend in sustainable finance, with global green deposit volumes estimated to have surged from negligible amounts in 2018 to billions of dollars by 2023. However, precise figures are challenging to ascertain due to differences in reporting standards and definitions among institutions.

…/…

15 Higher reserve requirements under a differentiated framework could introduce also higher volatility/non-fundamental changes in liquidity surplus, and, thus, complicate the forecasting of autonomous factors.

Several commercial banks have already developed "green deposit" programs. Financial institutions are already significant players in the green bond market. As an additional way to raise funds towards funding sustainable activities, some banks offer "green deposits" to their clients, including green savings accounts (green term deposits) and green current accounts (green sight deposits), which enable depositors to exercise greater influence over how their funds are allocated within the lending process. Some large banks globally have launched green deposit schemes, such as Bank of China (Hong Kong SAR), ICBC Asia (Hong Kong SAR), SMBC (Japan), MUFG (Japan), and Deutsche Bank (Germany), with minimum deposit requirements from USD 1 million to USD 50 million and terms up to 12 months. By opting for green deposits, individuals, corporations, and government agencies not only earn interest on their savings but also contribute directly to the financing of sustainability initiatives. Simultaneously, banks can facilitate increasing lending activity towards green initiatives.

In emerging markets, green deposits have gained notable traction with private sector initiatives. For example, Yes Bank (2024) in India launched its green deposit programme in 2022, focusing on financing renewable energy projects and sustainable agriculture initiatives across the country. DBS Bank has been particularly active in Southeast Asian markets, introducing green deposits in Singapore before expanding to Indonesia and India, while also developing specific frameworks for sustainable financing in sectors crucial to emerging economies. FirstRand Bank (2002) in South Africa pioneered green deposits in the African continent, integrating them into their climate finance strategy and focusing on renewable energy and water conservation projects, particularly targeting corporate clients in the mining and industrial sectors. Commercial Bank of Dubai (2022) in the UAE launched its green deposit offering in the same year, becoming one of the first banks in the Gulf region to introduce such a product, with proceeds specifically earmarked for financing transition activities to a low-carbon economy.

Greening benefits and possible options

Several aspects of reserve requirements and remuneration of reserves can be amended to incentivise green banking activity:

- *Quantity-based strategies:* reserve requirements apply to banks' short-term liabilities, typically deposits, such as demand deposits and other liquid deposits, which mainly result from private money creation (i.e., deposit-creating lending). Adjusting the scope of reserve requirements by some form of green criteria – potentially aligned with the LMA (2025) *Green Loan Principles*[16] (or *Sustainability-Linked Loan Principles*)[17] – can steer banks' incentives towards sustainable lending and investment activities. Central banks could consider offering reduced statutory reserve requirements, or even full exemptions, for funds allocated to green projects. This could involve a "carve-out" from reserve requirements for a specified portion of bank-offered green deposits or adjusting the scope of eligible deposits for funding green assets like green loans. This approach would incentivise banks to increase their green deposits, reducing their reserve requirements, while ensuring that these funds are used for environmentally sustainable projects. In countries with high reserve ratios, the minimum requirement for deposit funding supporting green initiatives could be lowered or eliminated without impacting the monetary policy stance.[18]
- *Price-based strategies:* central banks can encourage financial institutions to expand climate-related lending by differentiating remuneration rates based on the share of green deposits or green lending activities.[19]

16 For more information, see https://www.lsta.org/content/green-loan-principles/.

17 Sustainability-linked loans are loan instruments or contingent facilities (such as bonding lines, guarantee lines, or letters of credit) that encourage the borrower to meet specific sustainability performance goals. These goals are measured using sustainability performance targets (SPTs), which include key performance indicators, external ratings, or similar metrics to track improvements in the borrower's sustainability profile.

18 Reserve requirement ratios vary widely globally, but tend to be lower (or even zero) in advanced economies and higher in EMDEs (where they even reach double digits in some cases).

19 Reserve requirements can either be remunerated or non-remunerated. Non-remunerated reserves are effectively a tax on the banking sector but might be necessary (at least for the minimum requirement) to reduce the cost of absorbing excess system-wide liquidity. There is an ongoing debate among academics and policymakers about the "right way" to remunerate reserves. For instance, de Grauwe and Ji (2024) as well as Csávás *et al.* (2024) argue that reserves should not be fully remunerated to mitigate central bank losses. Some policymakers also support substantially increasing non-remunerated reserve requirement ratios (Schroers, 2025). However, it is important to ensure that marginal demand for reserves is sufficient so that the remuneration rate of excess reserves determines the floor to the effective policy rate in money markets.

During the period of negative interest rate policy (NIRP), some central banks have "tiered" the remuneration of reserves, i.e., paying different interest rates to different layers of reserves, so banks would not have to pay for depositing excess reserves with the central bank (Jobst and Lin, 2016). Following this example, a price-based measure of greening reserves could involve a tiered remuneration of reserves, with higher interest rates paid to these reserves. However, the impact of such a price-based differentiation is diminished when significant monetary easing implies a policy rate converging to the zero lower bound, thus, removing the necessary room for differentiation.

By embedding sustainability considerations into reserve requirement policies, central banks with a mandate to support the transition to a low-carbon economy can play a pivotal role in fostering sustainable finance. Differentiated reserve requirements provide an additional mechanism for central banks to influence the deposit-lending channel. Implementing lower reserve requirements for deposits funding specific green assets can encourage the growth of green lending. These actions create incentives for commercial banks to expand sustainable finance and by extension contribute to broader efforts aimed at greening the financial system.

Several limitations can constrain the potential greening of reserve requirements. Like other climate-related central bank policies, any adjustments to reserve requirements must align with the central bank's mandate and not disrupt monetary policy effectiveness. For instance, reducing the reserve requirement ratio or restricting the application of reserve requirements on deposits could increase system-wide liquidity and impact the monetary policy transmission. Implementing green reserve requirements may also pose operational challenges if there are limited green financial products or data on deposit-funded green lending available in the market, preventing the design of differentiated reserve requirement measures. In addition, concerns about prudential risks may arise from lowering reserve requirements without a clear assessment that greener counterparties pose lower risks; these risks are likely to be higher in many EMDEs where reserve requirements are relatively high and/or also serve a prudential purpose. Central banks must also consider the financial implications of altering remuneration policies, which may be more complex to adjust than quantity-based changes to reserve requirements.

Examples

Central banks in Lebanon and the Philippines have recently implemented regulatory changes to encourage green and climate lending by reducing reserve requirements (Box 3). This adjustment is intended to free up more funds, encouraging banks to offer more credit for sustainable projects that support environmental efforts and climate resilience. In the Philippines, this modification is part of a broader effort by local regulators to strengthen sustainable finance, while Lebanon's decision aligns financial regulations with environmental objectives. These measures are designed to spur investment in green and climate projects that can contribute to sustainable and resilient economic growth.

Box 3

Lower Reserve Requirements in Lebanon and the Philippines

The Central Bank of Lebanon provides partial exemptions from the mandatory reserve requirement related to the funding of loans granted to environmentally-friendly projects, including those in renewable energy, energy efficiency and green buildings since 2010 (Banque du Liban, 2010). Eligible green activities are defined based on a *de facto* environmental taxonomy that determines financial incentives, verification protocols and classification levels (particularly through LEED certification or its international equivalent). Reserve requirement reductions range from 90 to 150 percent of the environmental portion of loan balances, depending on the loan currency and whether the loan benefits from interest subsidies. …/…

The Central Bank of Philippines has lowered reserve requirements to promote the financing of green or sustainable projects, including decarbonisation activities (Bangko Sentral ng Pilipinas, 2023).[1] In addition to increasing the single borrower limit (SBL) for loans, credit, and guarantees, the central bank lowered the reserve requirement ratio (RRR) to zero percent for existing or new sustainable bonds issued by banks (as opposed to a RRR of 3 percent for non-green bonds). Projects or activities must align with the principles or categories outlined in (1) the *2022 Strategic Investment Priority Plan on Green Ecosystems, Health, and Food Security*,[2] (2) the *Republic of the Philippines Sustainable Finance Framework*, (3) the *Philippine Sustainable Finance Guiding Principles*, (4) the *ASEAN Taxonomy for Sustainable Finance*, or (5) the *Philippine Sustainable Finance Taxonomy Guidelines*. They must also comply with all Philippine environmental laws and regulations to be considered eligible. Even if an activity is prohibited, it may still qualify as an eligible exposure if it contributes to climate change mitigation.[3]

1 See also https://www.bsp.gov.ph/SitePages/MediaAndResearch/MediaDisp.aspx?ItemId=6949.

2 This pertains to the Tier II of the *2022 Strategic Investment Priority Plan* (green ecosystems, health security-related activities, and food security related activities) approved in Memorandum Order No. 61 dated 24 May 2022 (FIRB, 2024).

3 Sustainable bonds need to comply with relevant national, regional or international market standards (e.g., ICMA Green Bond Principles (2025) or the ASEAN Green Bonds Standards (2019)).

3.1.2 Green central bank short-term debt securities

General considerations

The issuance of central bank's short-term securities is an effective and market-friendly liquidity management tool, offering central banks greater autonomy compared to other instruments. Many central banks issue securities, such as monetary bills, to manage system-wide liquidity in the banking sector, ensuring excess reserves align with pre-defined target levels. The issuance (and amortisation) of these securities through open market operations (OMO) directly affects the central bank balance sheet and banking sector reserves.[20] Unlike direct instruments like minimum reserve requirements, which act as a general tax on financial intermediation unless fully remunerated, central bank securities are demand-driven and priced at prevailing money market rates, supporting effective monetary policy transmission. Other OMOs, such as repurchase or swap agreements, depend on the availability of eligible collateral, which might be difficult to implement in jurisdictions with a weakly developed local capital market (and create dependence on foreign currency-denominated collateral that could impinge on the effectiveness of the prevailing monetary policy framework). In contrast, the issuance of local currency-denominated central bank securities provides autonomy in this regard (and do not impact the monetary base). Central bank securities also boost banks' counterbalancing capacity to secure funding from the interbank market (rather than the central bank) during times of stress, which strengthens the central bank's role as lender of last resort (rather than first resort).[21]

Greening benefits and possible options

Central banks could consider incorporating climate considerations into the design of their short-term debt instruments. The issuance of monetary bills is a key tool used to absorb liquidity surplus from the banking sector for a specific period, depending on the maturity term of the issued securities. Central banks typically hold the proceeds in cash or cash-equivalent instruments with very short duration (removing any sustainability consideration by construction). Alternatively, as part of their strategic asset allocation and without prejudice to any statutory

20 According to the IMF's *Information System for Instruments of Monetary Policy* (ISIMP) database, more than 35 central banks currently issue monetary bills/short-term debt securities (Gray and Pongsaparn, 2015). These central banks include Bahrain, Chile, Sweden, Thailand, and the UAE, which could consider integrating sustainability considerations into their issuance programs. While having a pre-existing debt issuance programme is beneficial for promptly implementing this recommendation, it is not a requirement. Furthermore, some central banks issue certificates of deposits, which can also be utilised for promoting sustainability, although they may have a lesser signaling impact as they are not traded.

21 The absorption of excess reserves through the issuance of central bank debt securities does not increase the counterbalancing capacity in the banking sector but improves the availability of a highly-liquid and safe collateral asset for secured funding in the interbank market. Additionally, in some cases, central bank securities can support bond market development, addressing gaps where fiscal authorities do not issue sufficient securities to meet market demand for risk-free domestic currency assets, thereby helping establish a benchmark yield curve (Boonstra and van Geffen, 2022).

reserve management requirements (such as in the case of less flexible exchange rate regimes), central banks could use some of the issuance proceeds to directly finance (or refinance) eligible sustainable assets (through specialised asset management subsidiary/vehicle; Box 4), creating asset-backed "green monetary bills."[22] This new category of green financial instrument would require all (or a portion of) underlying assets to meet specific sustainability criteria, complemented by robust impact tracking mechanisms to monitor and report the environmental impact of funded projects. The resulting duration gap and liquidity risk would require augmenting the central bank's risk management framework and governance.

This approach provides incentives for banks to issue sustainable finance instruments. The inclusion of sustainability features in green monetary bills may lower the yield compared to traditional monetary bills, creating a "greenium," or improve other terms.[23] This can result in more favourable financing conditions for sustainable investments, as the high prices of eligible assets (or financial instruments referencing these assets) purchased by the central bank encourage banks to issue new eligible assets. By issuing short-term debt to fund longer-term assets on a rolling basis (and setting the interest rate floor), central banks can benefit from term structure transformation (Box 4). This allows central banks to support climate goals by signaling the value of sustainable investments and complement other indirect methods of incorporating climate considerations in the management of investment portfolios (NGFS, 2024c).[24]

Several limitations can, however, constrain the potential greening of monetary bills. In countries without a legislated sustainable finance taxonomy, the central bank would need to provide a *de facto* benchmark for what constitutes (eligible) sustainable activities to inform the screening criteria for the selection of eligible assets. Creating such a benchmark takes significant time and resources to implement consistently (and may involve legal challenges).[25] The issuing central bank would also need to carefully manage any credit, market and liquidity risk[26] from financing and holding sustainable assets over longer periods of time beyond the average maturity of issued monetary bills. Ideally, the sourcing of sustainable assets would supplement available commercial bank funding rather than crowding out private capital. If the risk and maturity profile of monetary bills and eligible assets differ significantly, measuring the overall benefit (and the degree of funding benefit, and, thus, effectiveness of issuing monetary bills to simulate the creation of sustainable assets) may be difficult.[27] Finally, the creation of green monetary bills could compromise the effectiveness of liquidity management as the primary objective of issuing short-dated central bank debt securities. The acquisition of sustainable assets initially injects liquidity into the banking sector, either *directly* (in the case of financial assets held by banks, such as infrastructure project loans) or *indirectly* (in case of real assets, such as infrastructure projects, resulting in higher bank deposits by corporates or government entities).[28] So green monetary bills only absorb surplus liquidity if the volume of underlying sustainable assets is smaller than the nominal issuance amount.[29]

22 Note that this approach to (re-)financing sustainable assets would ideally fall within the scope of public-private partnership arrangements/blended finance transactions sponsored by the government. However, efficiency gains from amending the issuance process and legal structure of existing monetary bills are likely to more than offset any additional running costs impacting central bank remittances to the government.

23 The term "greenium" generally refers to the yield difference between a green bond and its conventional equivalent. A positive "greenium" implies premium investors are willing to pay for funding green assets, which reduces the funding cost (Nederkoom and Scholten, 2024; Jobst *et al.*, 2024).

24 A recent NGFS (2024c) report examines how sustainable and responsible investment practices are being integrated into central banks' portfolio management frameworks, noting a growing trend toward incorporating ESG and climate considerations. For instance, Sveriges Riksbank (2019) chose, for climate reasons, to sell some federal government bonds in the foreign exchange reserves with particularly high carbon footprints, while Hungary's central bank established a green bond portfolio within its reserves (Paulik and Tapaszti, 2021b).

25 While most advanced economies have an official sustainable finance taxonomy or framework, this coverage drops to less than one-third in EMDEs (NGFS, 2025c).

26 In particular, asset duration, yield curve dynamics and liquidity mismatches would need to be considered.

27 For instance, most sustainable assets are likely to be infrastructure projects, which tend to generate very stable and predictable cash flows during their operational phase (and outperform corporate debt of similar credit quality over time) but entail significant default risk during construction (Jobst, 2025).

28 The financing of real assets would require specialist knowledge and interaction between the asset manager of the green monetary bills programme with government entities and infrastructure service providers, which is outside the core mandate of the CBUAE.

29 The importance of partial collateralisation has been considered in the design of the CBUAE's "Sustainable Islamic M-Bills" programme (Box 4).

The introduction of a green monetary bills programme could start with small-scale pilot projects and then expand based on market feedback and effectiveness in encouraging sustainable investments. The success of this gradual approach would rely on creating clear classifications, implementing strong verification processes, and maintaining transparent reporting systems to ensure credibility and effectiveness. This strategy would enable central banks to use these monetary bills as part of their structural open market operations to support environmental objectives while still meeting the responsibilities under their core mandate. However, the feasibility of greening central bank securities hinges on the availability of suitable assets and the expertise needed to develop a reliable financial instrument based on these assets.

Examples

The Central Bank of the United Arab Emirates (CBUAE) is the only central bank exploring the possibility of issuing green debt securities. In 2023, the CBUAE initiated the development of Shari'ah-compliant and sustainable-equivalent versions of its current monetary bills (M-Bills), which can serve as collateral to access the CBUAE's standing and liquidity insurance facilities. These "Sustainable Islamic M-Bills" not only provide a new safe asset to the local capital market, but also facilitate greater collateralisation among market participants while promoting equality between conventional licensed financial institutions and those operating in accordance with Shari'ah law (CBUAE, 2025). The first stage of the project concentrated on assessing the feasibility and potential scope of the programme, as well as setting up the legal framework, which will inform Board-level approval for implementation (Box 4).

Box 4

Case Study: Sustainable Islamic Monetary Bills (M-Bills) Programme

The CBUAE is currently developing a "Sustainable Islamic M-Bills" programme as an additional element of the Dirham Monetary Framework (DMF) to support the national sustainability agenda and enhance the prevalence of Islamic finance more generally. The programme aims to create a tradable Shari'ah-compliant[1] alternative to existing (conventional) M-Bills that also meets globally accepted sustainability criteria consistent with the UAE's sustainability agenda as defined in the *UAE Green Agenda 2015-2030*, the *National Climate Change Plan 2017-2050* and the *UAE Net Zero 2050 Strategy* (MOCCAE, 2015, 2017 and 2023). It will incentivise climate-smart investments that could be included as eligible assets for the programme. The asset-based nature of Sustainable Islamic M-Bills programme offers the opportunity to introduce sustainability considerations in the eligibility of the underlying collateral pool of reference assets.

The Sustainable Islamic M-Bills programme also supports the development of local money and capital markets. These M-Bills are expected to be issued regularly as tradable short-term, Shari'ah-compliant securities that can be used as collateral to either access the CBUAE's standing and liquidity insurance facilities or secure inter-bank lending. It will also offer domestic capital markets with sustainable and Shari'ah-compliant securities that can be traded locally, thereby creating a market for such securities.

In addition, the programme could help (partially) offset the cost of liquidity absorption. Issuing short-term debt securities by the CBUAE to refinance longer-dated assets can take advantage of term structure transformation in typical market conditions, such as an upward-sloping yield curve.[2] Even after factoring in transaction and administrative expenses, this approach can result in a positive operational net profit from any interest rate differential, thereby supporting cost-effective open market operations. …/…

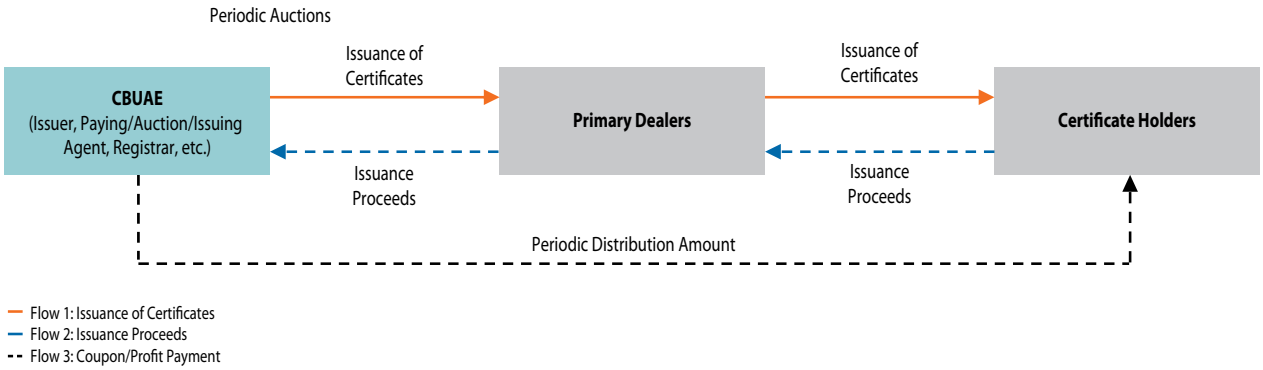
1 Non-permissible activities under Shari'ah principles (which includes alcohol production and sales, gambling and betting, pork-related products, adult entertainment, interest-based financial services, tobacco production and sales, weapons and defense manufacturing) do not conflict with sustainability requirements for the intended programme.

2 However, during episodes of an inverted yield curve, which has recently occurred in most advanced economies (2022-24), this strategy could introduce additional cost.

Background

In January 2021, the CBUAE introduced conventional M-Bills as part of its DMF implementation (Figure 4). The M-Bills programme forms a core feature of how the CBUAE manages banking sector liquidity, with the primary objective of absorbing surplus liquidity through structural open market operations. The bi-weekly M-Bills issuance also informs the pricing of the short end of the domestic risk-free yield curve as an interest rate benchmark for domestic debt securities, and, thus, supports the development of the local capital market. In addition, as important collateral for accessing CBUAE liquidity support, M-Bills facilitate the development of the secured interbank money market (CBUAE, 2022).

Figure 4 **CBUAE Conventional M-Bills Programme Structure**



However, the DMF also requires that the CBUAE's conventional liquidity management instruments have a Shari'ah-compliant equivalent. A core goal of the DMF implementation is to ensure parity between conventional licensed financial institutions and those that conduct their businesses and activities in compliance with the Shari'ah rules in terms of access to, and availability of, related liquidity management tools. At present, the current Shari'ah-compliant equivalent of the M-Bills programme is the commodity-*Murabaha* Islamic Certificates of Deposit (ICD) programme. However, ICDs are not tradable and are not issued through a competitive public auction, which limits their usefulness from the perspective of price formation. Therefore, a *bona fide* Shari'ah-compliant equivalent to conventional M-Bills should not only contain the key substantive features of M-Bills but also need to be tradable, issued via a competitive multiple-price auction system, and be used in repurchase agreements.

Programme Development and Implementation

The initial phase of the project focused on assessing the feasibility of the programme (since December 2023). A comprehensive analysis was conducted by a consortium of consulting and law firms to identify Shari'ah-compliant assets that meet certain eligibility criteria. This market study and feasibility analysis involved 132 entities, together with 62 LFIs, and provided critical insights into the domestic market for assets contributing to a low-carbon and climate-resilient economy.[3] The breadth and depth of the study provided – for the first time – a holistic view of the size and composition of the domestic market for sustainable assets.[4]

.../...

3 Shari'ah compliance involved enterprise-wide permissible activities, Islamic certifications, compliance with Accounting and Auditing Organization for Islamic Financial Institutions (AAOFI) standards and/or Shari'ah approvals by the respective company's Shari'ah Committee.

4 The CBUAE also requested LFIs to disclose their holdings of Shari'ah-compliant green/ESG assets.

The eligibility assessment involved a comprehensive review of globally recognised sustainability principles and standards, such as the *Climate Bond Initiative Standard* and the *ICMA Green Bond Principles*, as well as regulatory guidance, accounting for their alignment with the national agenda and applicability in the context of the UAE.[5] A draft *Programme Sustainable Framework* was developed that combines Shari'ah principles with the results of the comparative study and gap analysis of existing environmental, social and governance ESG methodologies and metrics.[6]

The CBUAE also developed the optimal legal structure and established the necessary administrative infrastructure, governance, and policies. The legal structure follows an asset-backed commercial paper (ABCP) arrangement and related structured finance rating methodologies adapted to Islamic finance for issuing Shari'ah-compliant securitisation instruments. The CBUAE's Higher Shari'ah Authority will be in charge of assessing the programme's compliance with Shari'ah principles (Figures 4 and 5).

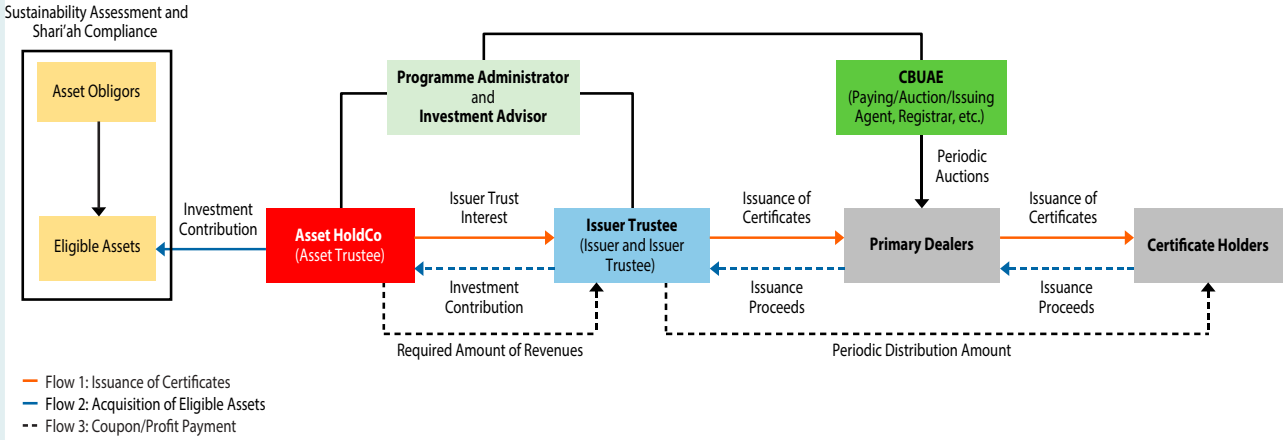
Programme Mechanics and Structure

Basic Structure (Figure 5). A programme administrator will manage the programme including the management of assets, the monitoring of the auctions, as well as the origination and structuring of the underlying asset transactions. A limited purpose company will be incorporated onshore as an asset holding company ("Asset Holdco") to acquire eligible assets (which must be domiciled in the UAE). An offshore special purpose company ("Issuer") issues trust certificates ("Certificates") in series, with the flexibility to issue additional Certificates of an existing issuance series by way of a "tap" issuance (with each issuance under a series being a "Tranche").[7]

Issuance Process and Use of Proceeds. The CBUAE will regularly hold auctions (as competitive tenders) based on prescribed tender process rules and agency agreement to allocate Certificates in accordance with an issuance calendar published by CBUAE. As part of the

…/…

Figure 5 **CBUAE Sustainable Islamic M-Bills Programme Structure (indicative)**



5 Including alignment with the UAE's *Principles for the Effective Management of Climate-related Financial Risks* (SFWG, 2023) and the *Principles for Sustainability-Related Disclosures for Reporting Entities* (SFWG, 2024), which resulted from close collaboration of national supervisory authorities in the *UAE Sustainable Finance Working Group* (SFWG), which was established in 2019.

6 Investors and organisations use ESG to make responsible and sustainable decisions. The framework is used to evaluate how companies manage risks and opportunities related to these three dimensions.

7 Note that the funding of collateral assets entails material credit and liquidity risks. Given the substantial system-wide excess liquidity in the UAE, resulting in a significant accumulation of central bank reserves (and high monetary base cover ratio), the CBUAE is in a very strong position with regard to its balance sheet to pursue this programme. However, without similar circumstances, it might be difficult for other central banks to initiate the investment leg of this programme.

issuance process, the CBUAE will be the auction agent, paying agent, and registrar. The issuance proceeds will be applied by the Issuer Trustee and the Asset Trustee (Figure 5) in accordance with the terms of the relevant transaction documents and shall include a payment on the relevant issue date: (1) by the Issuer Trustee towards making an investment contribution to the Asset Trustee for the relevant issuer trustee ownership interest being declared by the Asset Trustee over the relevant asset trust property; and (2) by the CBUAE Subsidiary of an amount required to cover timing mismatches if and when required.

Current Status

The preparatory work for programme approval has been completed. Building on a comprehensive feasibility analysis as well as finalisation of the design and assessment of an effective legal structure, work will proceed on preparing implementation options and seeking approval from the CBUAE Board. Once operational, the programme would be the first of its kind worldwide, supporting the continuous growth of Islamic capital markets and sustainable finance in the UAE.

3.2 Advancing existing asset-side measures

Enhancing the effectiveness of longer-term monetary policy operations is a so far relatively under-explored way of greening asset-side measures. Lending operations conducted by central banks can tilt structural refinancing operations towards green investments by adjusting their pricing. Together with amendments to collateral frameworks, they form a core element of previous NGFS papers on greening monetary policy operations.[30] Longer-term refinancing operations, can in certain situations serve as a crucial monetary policy instrument, providing banks with stable and predictable funding conditions that extend beyond short-term horizons. In the design of these operations, central banks can set attractive funding conditions to ensure sufficient and stable take-up by a broad set of monetary policy counterparties who would, then, channel that liquidity to the transition to a low-carbon economy. The benefits of such incentives would need to be weighed against the impact that such preferential interest rates would have on the central bank's finances. Annex 1 provides a comprehensive explanation of potential options for greening credit operations over the longer term.

In addition, where their mandate allows, central banks could consider expanding the current scope of asset-side measures, including by: (1) integrating climate-related considerations and practices of investment management into monetary policy operations, (2) widening the eligibility criteria for liquidity support to non-bank financial institutions involved in climate adaptation or mitigation efforts, and (3) providing emergency funding as quasi-backstops for climate-focused government investment initiatives (in the context of closer monetary-fiscal coordination).

Learning from the experience of central banks that have included climate and sustainability considerations in their asset management of non-monetary portfolios could help further enhance related aspects of monetary policy operations.[31] Several central banks have begun integrating climate and/or sustainability considerations into their strategic asset allocation, either explicitly as an additional policy/investment objective or implicitly by incorporating climate considerations into broader risk management frameworks (NGFS, 2024c; Fender *et al.*, 2020 and 2022; BIS, 2022). Any sustainability metric and implementation method/governance for shifting the non-monetary portfolio towards "green(er) assets" might also be applied to monetary portfolios (including in the context of asset purchase programs and repo transactions), such as the determination of collateral eligibility and valuation haircuts. Aligning asset allocation choices with environmental goals involves relying on devices such as carbon emissions data, green labels, and more broadly ESG metrics, as well as sustainability taxonomies. While challenges such as data limitations, asset class eligibility, and potential trade-offs with traditional objectives remain, some central banks have made significant changes in

30 Also note that existing efforts to adjust pricing/access to central bank money via credit operations and any amendments to collateral framework would also need to take into account a higher climate-sensitivity of credit ratings that inform eligibility. For instance, providers may be requested/required to include climate risks into the rating information, with knock-on effects on valuation haircuts.

31 In some cases these efforts are coordinated with similar actions in non-monetary policy portfolios.

the composition of their monetary policy portfolios (ECB, 2024a).[32]

Several central banks, especially in EMDEs, are also developing specialised accounts and dedicated liquidity facilities for NBFIs involved in sustainable projects and adhering to sustainability standards. These facilities aim to channel funding toward environmentally sustainable activities while ensuring NBFIs meet specific environmental criteria. For instance, Bangladesh Bank has introduced green refinancing schemes offering subsidised rates for renewable energy and sustainable agriculture projects, with NBFIs required to meet established environmental criteria (UNCTAD, 2023; Dikau and Ryan-Collins, 2017). These initiatives show how central banks could use their regulatory and monetary "tools" to promote sustainable finance through the NBFI sector, although the specific approaches and requirements vary across jurisdictions.[33]

Central banks – with appropriate mandates – could also contribute through their monetary policy operations to fiscal strategies aimed at scaling green investments, as long as this does not compromise their independence and without prejudice to other aspects of their mandate. Successful initiatives during the Covid-19 pandemic, such as targeted and time-bound risk-sharing partnerships for emergency measures (Ryan-Collins *et al.*, 2023), may offer lessons for more permanent arrangements to facilitate climate transition in a way that is similar to the role of public-private partnerships and de-risking mechanisms in public investment management. In this context, central banks might help create fiscal space, including by purchasing government-backed green bonds (NGFS, 2021) and providing liquidity support to special purpose vehicles (SPVs) that fund climate-related investment projects and initiatives. Such coordinated actions contribute to macroeconomic stability and climate resilience, but hinge on effective institutional collaboration, the use of transparent risk metrics, and clear policy signals across both monetary and fiscal domains. So far, central bank actions in relation to fiscal sustainability initiatives have been focused on technical assistance and the removal of structural barriers.[34] However, any monetary-fiscal coordination would need to remain mindful of central bank independence and the prohibition of monetary financing in many jurisdictions.

32 In July 2022, the European Central Bank (ECB) decided to tilt its reinvestments in order to reduce the emissions of corporate bonds holdings in its monetary policy portfolios and mitigate climate-related financial risks. Internally, the Eurosystem has established minimum common standards for incorporating climate-related risks into the in-house credit assessment systems of national central banks. Similarly, the Bank of England has set targets for reducing the weighted average carbon intensity of its corporate bond holdings. Furthermore, the Eurosystem will only accept marketable assets and credit claims as collateral in its credit operations from companies and debtors that comply with the *Corporate Sustainability Reporting Directive* (CSRD). This requirement will apply to all companies within the scope of the CSRD, following its implementation. Relatedly, from the second half of 2026 onwards, the ECB (2025) will introduce a climate in its collateral framework to address climate-related transition risks.

33 Other notable examples include: (1) the Bank Indonesia launched a green financing facility for NBFIs focusing on sustainable agriculture, renewable energy, and green buildings, offering favourable terms for qualifying projects; (2) the Reserve Bank of India (RBI) has implemented a priority sector lending programme for commercial banks, which provides renewable energy sector as an option to deploy the mandatory priority sector credit; (3) Central Bank of Brazil (BCB) introduced the *Rural Credit National Programme* with specific provisions for sustainable agriculture and forestry projects, including preferential terms for NBFIs financing these activities; and (4) the Monetary Authority of Singapore (MAS) established the *Sustainable Bond Grant Scheme* (SBGS), which encourages the issuance of green, social, sustainability, and sustainability-linked bonds, covering the issuer's additional cost of obtaining an external review on the impact of such bonds.

34 For instance, when the UK government announced its intention to issue green gilts, the Bank of England confirmed that these green gilts would have equivalent eligibility to existing gilts in its market operations.

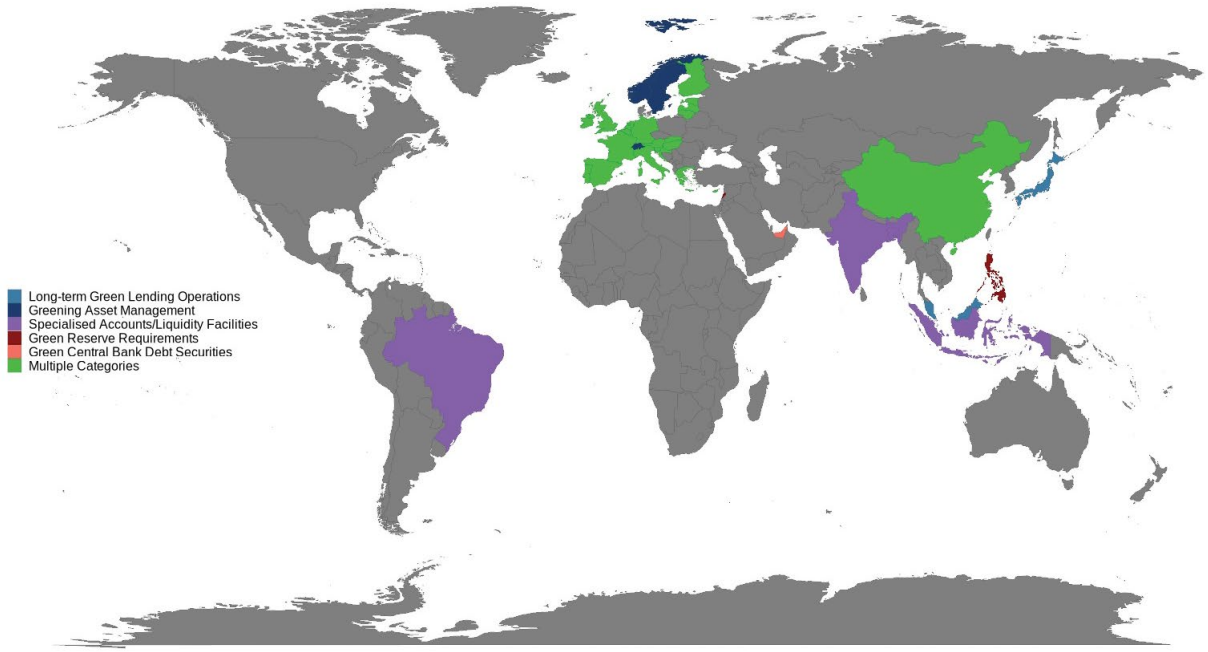
4. Practical challenges and how to address them

4.1 Widening the scope

Greening monetary policy operations to encompass the entire central bank balance sheet would be a significant increase in central bank climate actions. In recent years, several central banks have already adjusted the terms and conditions of their credit operations and asset purchase programs to account for climate-related factors (Figure 6). Certain central banks have linked access and/or pricing to climate considerations, while others have adjusted their collateral framework by changing collateral eligibility criteria or valuation haircuts. Adjustments to asset purchases have involved targeting issuers with eco-friendly practices (such as verified compliance with climate risk or sustainability disclosure standards) or screening securities based on climate-related risk factors. Newer initiatives also involve integrating sustainability standards into reserve management practices, which could be adapted for use in monetary policy portfolios, as well as providing liquidity support for non-bank financial institutions engaged in sustainable initiatives (possibly together with specialised accounts at the central bank).

On the liabilities side, efforts to promote environmental sustainability are still in the early stages of development but could enhance climate sensitivity as central banks address excess reserves in the system. Considering climate-related risk factors when determining minimum reserve requirements could be a viable option, but only a limited number of central banks have taken steps in this direction. Moreover, central banks in jurisdictions with excess reserves could also consider incorporating environmental considerations into the issuance of short-term debt securities or certificates of deposit, which would help absorb surplus liquidity while offering financial incentives for climate-friendly investments. To date, only one central bank has explored this approach. Overall, implementing measures on both sides of the balance sheet can reinforce climate-related incentives throughout the monetary cycle and provide ongoing support for climate objectives where these are consistent with central banks' mandates (Table 2).

Figure 6 **Geographical overview of greening monetary policy operations (by country)[1]**



1 Disclaimer: The boundaries, colors, denominations, and any other information shown on the maps do not imply, on the part of the Network for Greening the Financial System or its member institutions, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.
Note: Grey shading = no reported measure; all countries with "green" credit operations/liquidity facilities (Euro area, Hungary, UK) have also introduced climate considerations into asset management (asset purchase schemes, reserve management) and are captured as "multiple categories". The only other country in "multiple categories" is P. R. China ("green" reserve management and long-term green lending operations).
Source: Authors.

The introduction of liability-side policy instruments for greening monetary policy operations is expected to impact the balance sheets of the central bank, the banking sector, and the rest of the economy. The impact of these measures (e.g., minimum reserve requirements, short-term debt securities issuance) on financial flows will depend on their technical specification (in terms of financial incentives), banks' reaction to changes in their liquidity position, and overall financing conditions in the economy. We distinguish between two phases in each scenario for green reserve requirements and green monetary bill issuance, respectively. In the first phase, each tool generates additional liquidity through higher excess reserves (either by reducing the minimum reserve requirements by [x]% or purchasing sustainable assets from banks at a premium of [y]% to collateralise the issuance of sustainable monetary bills); in the second phase, banks use the additional liquidity to increase lending. These scenarios are depicted using simplified balance sheets of the central bank, domestic banks, and the general public (comprising households, businesses, and the government excluding the central bank). Table 3 below summarises the scenarios.

If greening monetary operations is effective, it is expected to increase the banking sector's balance sheet. As an illustration, for a 10%-reduction in the reserve requirements, commercial banks will see an increase in excess reserves; the liquidity surplus declines once banks start funding new lending (consistent with a money multiplier of 1/10% = 10), which increases their balance sheet (if there are sufficient new lending opportunities). For the issuance of green monetary bills, a similar picture emerges as banks benefit from the refinancing of their sustainable assets at a premium, which allows them to fund new loans using the profits from the asset sale to the central bank (Table 3).

Whether this is compatible with central banks' primary objectives depends on a range of factors. Expanding the central bank balance sheet can help provide monetary stimulus. However, it may also create material trade-offs between supporting climate action and a tighter monetary stance since the release of "high powered" money via a lower reserve requirement has a significant impact on leveraged returns from lending. In addition, in some countries, high reserve requirements also serve a prudential purpose, and any reduction might conflict with capital and/or liquidity risk management requirements, diminishing its operational feasibility.

Table 2 **Conceptual framework for greening monetary operations**

Activity/Instrument		Measure		Usage**
Assets	**Credit Operations and Liquidity Facilities**[1]	Adjust Pricing/Tenor *(based on …)*	Climate-related lending	Yes
			Type of collateral	No
		Widening Eligibility[3]		Yes
		Risk-Sharing/Monetary-Fiscal Coordination		No
	Collateral Framework*	Adjust Haircut		Yes
		Screening	Positive	No
			Negative	Yes
		Aligning Collateral Pools		No
	Asset Management[2]	Tilting		Yes
		Screening	Positive	Yes
			Negative	Yes
Liabilities	**Liquidity Management**	Reserve Requirements[4]	Carve-out/minimum ratio[6]	Yes
			Remuneration[7]	No
		Central Bank Securities[5]		Planned***

*Note: CB = central bank; the red borderline indicates additions to the existing conceptual framework for greening monetary operations covered in this paper, building on the previous recommendations in NGFS (2021 and 2024); */ can also have implications for the liabilities side of the central bank balance sheet for reverse repo transactions; **/ dark/medium/light green indicates at least 5/2 countries/country applying the measure; ***/ planned; 1/ jurisdictions with active use (6): P. R. China, Euro area, Hungary, Japan, Malaysia, and the UK; 2/ jurisdictions with active use (9): P. R. China, Euro area, France, Hungary, Netherlands, Norway, Sweden, Switzerland, and the UK; 3/ jurisdictions with active use (5): Bangladesh, Brazil, India, Indonesia, and Singapore; 4/ jurisdictions with active use (2): Lebanon and the Philippines; 5/ e.g., monetary bills, certificates of deposit; 6/ lower reserve requirement if deposit funding is used for climate-related lending; 7/ (higher) remunerations of reserves for deposits that fund climate-related lending.*
Sources: NGFS (2021 and 2024a) and authors.

Table 3 **Balance sheet impact of greening monetary operations**

		Green Reserve Requirement		Green Monetary Bills		
		Lower Reserve Requirement	Lower Reserve Requirement, New Lending	More M-Bill Issuance (no Asset Purchases)	More M-Bill Issuance (with Green Asset Purchases)	More M-Bill Issuance (with Green Asset Purchases) and New Bank Lending
		Scenario 1a	*Scenario 1b*	*Scenario 2a*	*Scenario 2b*	*Scenario 2c*
	Current					
Central Bank						
Assets	790					
• Domestic	55				+33	+3
• Foreign	695					
• Other	40					
Liabilities	840					
• Required Reserves	300	-30				
• Excess Reserves	150	+30		-50	-17	-47
• Currency in Circulation	135					
• Securities	215			+50	+50	+50
• Other	40					
Total	*840*	*840*	*840*	*840*	*873*	*843*
Balance Sheet Impact of Greening Measure		*Reallocation*	*Unchanged*	*Reallocation*	*Increase*	*Increase*
Banking Sector*						
Assets (Domestic)	3,190					
• Required Reserves***	300	-30				
• Overnight Deposits (CB, interbank)	150	+30		-50	-17	-47
• Loans	2,400		+270		-30	
• Securities	340			+50	+50	+50
Liabilities (Domestic)	3,140					
• Deposits	2,500		+270			
• Non-Deposit Funding	500				+3	+3
• Other	140					
Total	*3,140*	*3,140*	*3,410*	*3,140*	*3,143*	*3,143*
Balance Sheet Impact of Greening Measure		*Reallocation*	*Increase*	*Reallocation*	*Increase*	*Increase*
General Public**						
Assets (Selected)	2,635					
• Deposits	2,500		+270			+27
• Currency in Circulation	135					
• Non-Bank Lending						
Liabilities (Selected)	2,400					
• Loans	2,400		+270			0
• Other Liabilities	0					
Other (net worth)	235					
Total	*2,635*	*2,635*	*2,905*	*2,635*	*2,635*	*2,635*
Balance Sheet Impact of Greening Measure		*Reallocation*	*Increase*	*Unchanged*	*Unchanged*	*Increase*

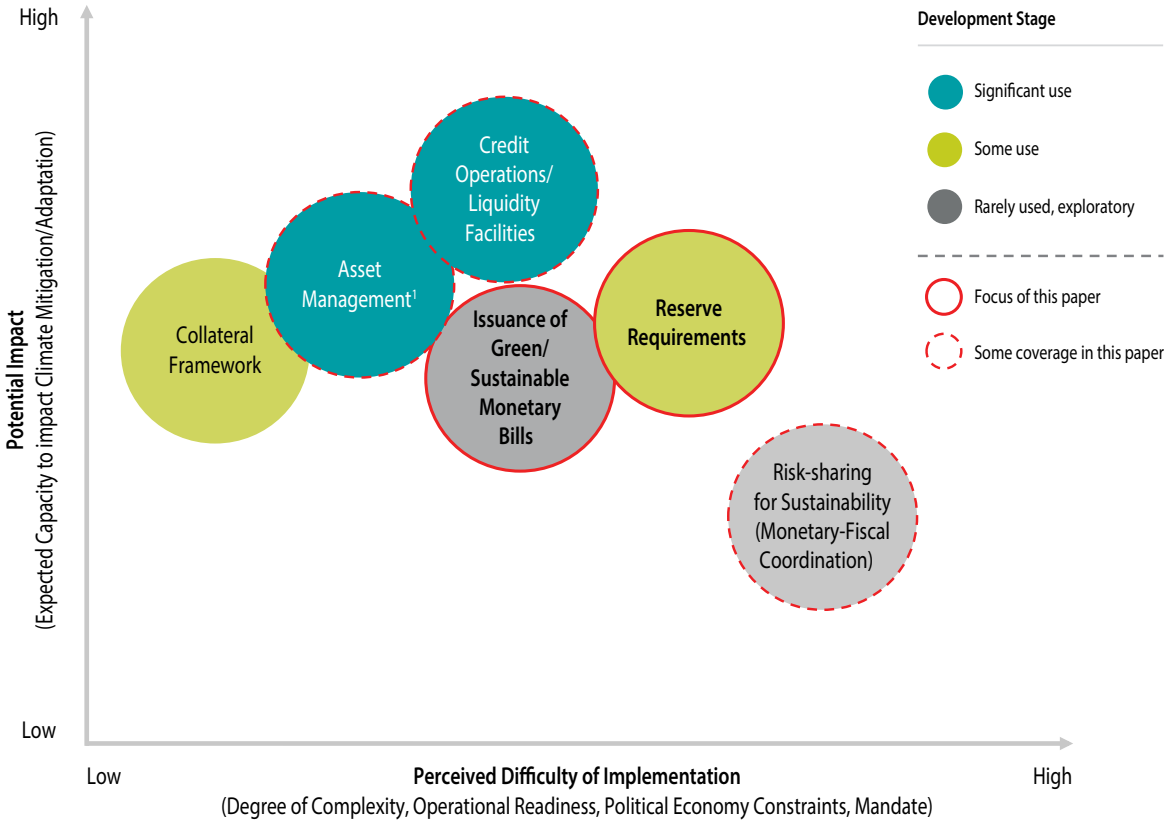
*Note: */ domestic activities only; **/ general public = households, businesses, and government (excluding the central bank) as well as non-bank financial institutions, ***/ reserve requirement assumed to be 10% of the deposit base. We distinguish between two "greening" measures (minimum reserve requirement (RR), short-term debt securities issuance) and different reactions of the banking sector: Scenario 1a (central bank reduces the RR by 10% by exempting – in full (or partially) "green commercial bank deposits" and banks hold more cash), Scenario 1b (same as Scenario 1a but banks use all released liquidity reserves to originate new loans), Scenario 2a (central bank issues conventional monetary bills to absorb excess reserves), Scenario 2b (central banks issues "green" monetary bills but collateralise them bywhose issuance proceeds refinance refinancing "green (project) loans" from the banking sector as underlying assets by – central bank can offering offer a premium of 10% over the current price of loans due to the term structure benefit from using a (short-term) asset-backed commercial paper (ABCP) funding structure using a (short-term) asset-backed commercial paper (ABCP) funding structure), and Scenario 2c (same as Scenario 2b but banks use released liquidity the premium from the asset sale to originate new loans). Scenarios 2a-2c assume that the issuance of monetary bills occurs in an environment of excess reserves, and the asset acquisition in Scenarios 2b-2c is consolidated on the central bank balance sheet (for simplification). Source: Authors.*

4.2 General cost-benefit considerations

Central banks looking to incorporate climate-related goals into monetary policy operations could enlist a variety of measures across their balance sheet – depending on the scope of their mandates. The main advantage would be to reduce climate-related financial risks to their own balance sheet and in the financial system more widely, and promote sustainable investments. For instance, implementing differentiated reserve requirements can encourage banks to hold environmentally-friendly assets and attract green deposits, making them more appealing in liquidity management. Additionally, targeted asset purchases can directly support sustainable finance and reduce the cost of capital for sustainable investments. The introduction of green monetary bills could act in a catalytic way by generating additional demand for assets that meet sustainability criteria, establishing a screening taxonomy for such assets, and accelerating the development of green short-term debt instruments.

The benefits of greening monetary operations must be balanced against possible drawbacks and constraints. It is essential to carefully assess the potential effectiveness of selected "tools" and measures against their (perceived) difficulty of implementation while considering the implications of the respective monetary framework, legal requirements, and market conditions. These may include increased operational complexity, adverse impacts on monetary policy transmission, higher compliance burdens and data/verification needs, as well as the risk of unintended market distortions. The potential impact of key measures to green monetary operations, such as issuing green monetary bills or greening reserve requirements, is relatively high. However, these measures increase operational complexity (Figure 7). In contrast, amendments to credit operations and, to a lesser extent, the collateral framework may have a weaker "climate incentive strength." This is particularly true when system-wide liquidity is high, and access to central bank money involves little to no opportunity cost. Despite this, implementing these amendments is generally less challenging (Table 4). For "market neutrality risk", changes in the specific conditions

Figure 7 **Impact *vs.* feasibility trade-off of various options**



Note: Trade-off considerations reflect the results from a survey-based assessment from 11 member jurisdictions of the NGFS; 1/ comprising both asset purchases and reserve management (if relevant for monetary policy), whereas the latter is a new element covered in this paper.
Source: Authors.

Table 4 **Considerations for greening monetary operations**

	Measure	Climate Incentive Strength	Persistence of Effect	Operational Complexity	Market Neutrality Risk	Data/ Verification Needs
Assets	Credit Operations/ Liquidity Facilities	Medium-High	High	Medium-High	Medium-High	Medium-High
	Collateral Framework	Medium	Medium-High	Medium	Medium-High	Medium-High
	Asset Management[1]	Medium-High	Medium-High	Medium	High	Medium
	Risk-sharing (Monetary-Fiscal Coordination)	Medium-Low	Medium	Medium-High	Medium	Medium
Liabilities	Reserve Requirements	Medium*	Medium	Medium-High	Medium-Low	Medium-High
	Central Bank Securities	Medium	Medium-High	Medium-High	Medium-Low	Medium-High

*Note: The categorisation reflect the results from a survey-based assessment from 11 member jurisdictions of the NGFS; */ if minimum reserves are remunerated, cyclical changes in the policy rate will influence the structural effectiveness of greening the reserve requirement since deposit volumes increase as interest rates increase (Repullo, 2023); 1/ asset purchases and reserve management (if relevant to monetary policy).*
Source: Authors.

governing the scope and implementation details of asset purchases (and, to some extent, the terms and conditions of credit operations) can substantially influence asset prices without necessarily distorting effective market functioning. However, amendments to central bank securities issuance and reserve requirements entail a significantly lower risk of compromising market neutrality. Data and verification needs are considerable for most greening measures, such as the design and implementation of reliable and comparable sustainability metrics based on clear disclosure standards (preferably based on a legislated country-wide taxonomy). The evaluation of the balance between climate impact and operational feasibility using these criteria is typically context-specific and heavily influenced by local conditions.

Some greening measures may involve initial costs and require time to be implemented but could boost climate-related investment over the long term. Central banks would need to effectively manage transitional challenges, such as temporary disruptions in capital markets and changes in bank funding structures, to realise the lasting advantages of greening monetary operations. For example, adjusting reserve requirements to promote green initiatives could release a substantial amount of cash by affecting the money multiplier, requiring detailed impact analysis on its implications for monetary aggregates (and credit dynamics) as well as potential revisions to existing prudential regulations (and their interaction with the monetary policy framework). Moreover, adjustments to reserve remuneration (if applicable) may pose greater challenges in terms of design compared to quantity-based modifications. This is because they not only necessitate the verification of green lending to segregate eligible short-term liabilities for differential treatment but also entail a calibration process to determine what qualifies as a significant change in reserves to provide adequate financial incentives for banks to meet the criteria for such treatment (in comparison to traditional short-term funding). In contrast, modifications to the collateral framework are typically evaluated at the operational level of central banks and can be implemented more swiftly.

Overall, phased introductions of new measures allow financial institutions and markets to adapt gradually, minimising the risk of sudden disruptions and enabling central banks to monitor and evaluate the real-world effects of their interventions systematically. An incremental approach also helps authorities identify unintended consequences, refine operational frameworks, and make data-driven technical adjustments as necessary. Pilot programs, in particular, provide valuable opportunities to test new "tools" on a small scale, gather empirical evidence, and form the development and broader implementation of effective climate-related monetary policies. Drawing from case studies of previous initiatives to green monetary operations (NGFS, 2024b), central banks also acknowledge the importance of addressing asymmetric information on climate risks and their implications for monetary policy. There is a consensus that this challenge can be addressed through clear, standardised, and adaptable taxonomies that promote transparent and reliable disclosure to facilitate effective risk management and business planning.

5. Concluding remarks

Incorporating climate considerations across both the assets and liabilities of central banks can deliver reliable, persistent and meaningful greening of monetary operations. The current focus on integrating climate change mitigation and adaptation into monetary policy operations affecting central bank assets is intuitive; however, the impact of asset-side measures can be limited during periods of excess system-wide liquidity and in monetary policy frameworks that operate with structural liquidity surplus. Thus, it is useful to extend consideration to the other side of the balance sheet.

This paper broadened the scope of existing NGFS thinking. It explored how central banks can also include environmental objectives in their liabilities, such as reserve requirements and central bank-issued debt securities, and by embedding these considerations into "tools" that function "through-the-cycle," such as long-term refinancing operations. In this context, additional options for greening credit operations are provided. Ultimately, a comprehensive, structurally robust approach that addresses both sides of the balance sheet provides a greater range of options to central banks whose mandate allows them to directly support the climate transition in support of government initiatives.

When selecting and designing climate-aligned monetary policy "tools," central banks must carefully consider the extent of their mandates as well as legal requirements and market conditions, as each tool presents distinct benefits, costs, and implementation challenges. Most importantly, adopting a comprehensive approach to integrating green practices into monetary operations, which includes policies on the liability side, goes beyond simply safeguarding against climate-related financial risks. Thus, it is essential for such measures to align with the mandates and operational frameworks of central banks that have the capability and desire to incorporate broader climate-related factors into their monetary operations. This may not be suitable for all central banks, particularly those where backing government climate initiatives could interfere with their ability to fulfill their mandates for price or currency stability. In addition, the advantages of greening monetary operations in reducing climate-related financial risks and encouraging sustainable investment also needs to be weighed against potential drawbacks, such as increased operational complexity, impacts on monetary policy transmission, compliance burdens, competitive effects, and unintended market distortions. Transitional challenges – such as shifts in bank funding structures or temporary market disruptions – must be duly managed to secure long-term resilience and sustainable growth. Phased introductions and pilot programs allow for gradual market adaptation, systematic monitoring, and evidence-based policy refinement, while standardised taxonomies help address information asymmetry and support transparency in climate change risk management.

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Annex 1 – Green Targeted Refinancing Operations

General considerations

Longer-term lending/refinancing operations can serve as a crucial monetary policy instrument, providing banks with stable and predictable funding conditions over longer time horizons. Credit operations are one of the "tools" to provide liquidity to the banking sector. While these operations have proven particularly valuable during crisis times and periods of temporary market stress, their importance may extend to normal market conditions by creating a reliable funding environment that enables banks to make longer-term lending decisions, especially crucial for sustainable investments that typically require extended time horizons. Refinancing operations that cover a longer time horizon offer reliable funding at predictable costs; this helps financial institutions better plan and execute their sustainable lending strategies, especially in the context of capital-intensive investments, reducing uncertainty in their intermediation role. This section expands on current NGFS (2024b) work by distinguishing more clearly between the greening of general credit operations and longer-term refinancing operations, given that the latter have some unique features.

Longer-term lending/refinancing operations could be tilted towards green investments by including conditionality. Central banks might consider setting attractive pricing conditions if eligible borrowers channel new liquidity to support green investments. Targetting credit operations could effectively bridge the gap between monetary policy objectives and sustainability goals, creating a positive spillover where central bank funding directly supports the transition to a low-carbon economy.

Defining and measuring green investment is crucial for maximising the benefits of green lending. The definition of green lending can be tied to lending and investments that facilitate climate change mitigation or adaptation based on established principles and standards for sustainable activities. Where available, a legislated and well-established green taxonomy and disclosure regime can serve as a framework for determining which loans qualify as green investments, while also keeping the central bank impartial in defining what is considered "green". An advantage of using measures based on the carbon intensity embedded in banks' portfolios is that they are already reported by many institutions in some jurisdictions. Many national competent authorities (NCAs) already use such information to assess how credit institutions monitor carbon emissions arising from their activities and withstand climate change-related risks.[35] Similar indicators/metrics could be employed by central banks to facilitate the monitoring of dedicated facilities that provide targeted funding. It is important to consider that the complexity of the chosen green metric may result in financial gains being offset by reporting expenses. This challenge can be partially addressed by leveraging existing data and widely accepted metrics.

Greening benefits and possible options

Structural liquidity facilities targeted at sustainability objectives provide several incentives that can help central banks drive the shift towards a more environmentally-friendly financial system. However, implementing structural liquidity facilities requires a careful assessment of their potential impact without prejudice to the monetary policy stance and the market neutrality principle, especially in financial systems where banks are significant players in funding the real economy (Box A1). The following effects are noteworthy:

- *Quantity effect:* by offering incentives for banks to fund sustainable projects, lending programs encourage more financing for green investments, resulting in a beneficial environmental impact over time.
- *Price effect:* improved lending terms encourage businesses to implement sustainable technologies and best practices in their projects.[36]
- *System-wide effect:* investing in green projects not only helps mitigate systemic environmental risks and enhance business resilience to climate-related impacts but also contributes to reducing the banking sector's exposure

35 i.e., climate-related financial risk from the loan book and the contribution of a banks portfolio to climate change ("double materiality").

36 Competition among banks is necessary to ensure that lower borrowing costs are passed on to borrowers in the form of better financing terms.

to environmental liabilities, ultimately strengthening financial stability in the long term.[37]

In the past, targeted refinancing operations (TROs) – without a focus on funding sustainable activities – have proven to be an effective policy tool to spur lending and stimulate real growth. According to this scheme, banks can borrow funds from central banks at more favourable conditions if specific criteria are met (ECB, 2021c). For example, the ECB introduced its targeted long-term refinancing operations (TLTROs) programme in 2014 to support monetary policy transmission by incentivising bank lending to the real economy.[38]

There are two main options to implement a green lending facility. One option is to direct the proceeds towards sustainable investments, such as projects that have a significant positive climate impact, such as renewable energy projects, energy efficiency upgrades, and pollution control initiatives. Borrowers would be required to report on the environmental impact of these projects and cannot use the same project for multiple sources of green financing. Another option is for the central bank to offer favourable funding only (1) if borrowers can pledge pre-defined "green" collateral or (2) to borrowers with a qualifying climate risk profile, taking into account their entire balance sheet (or specific parts of it). Both approaches can incentivise banks to increase their green lending, but it is still unclear which would be most effective. Green lending programs also involve auditing the environmental claims of financial institutions, which can help reduce the risk of greenwashing. Over the last few years, several central banks have made significant progress in this area. Box A1 discusses the main trade-offs in the parametrisation of "green" lending operations.

Box A1

Trade-offs in Designing and Implementing "Green" Lending Operations

A high green spread provides a strong price incentive for green investment but increases cost for the central bank. Jourdan *et al.* (2024) propose a green spread (i.e. a difference between the interest rate charged for 'green' vs 'non-green' lending) of 100-200 bps and expect that this would provide a tangible effect in stimulating green lending. For some central banks this may be too large and raises questions of profitability and mandate. However, a too small incentive could get lost in frictions (e.g., reporting costs) and be hard for banks to transmit to borrowers.

Also non-price incentives (e.g., term extensions or increased allocation limits) can help. Term extensions are a more cost-effective option and can still make borrowing appealing (partly due to regulatory considerations and partly due to term premia). Increased allocation limits can also help increase participation in credit operations with favourable pricing since borrowers are less likely to be rationed. In this scenario, the magnitude of these allocation limits can act as an incentive.

Furthermore, it is essential to maintain continuity in order to offer incentives for green investment, especially given their long-term nature. Green projects often require financing over many years, while traditional lending operations typically have shorter durations. Banks are more inclined to pass on benefits if they have confidence in the ongoing availability of green lending facilities. Aligning the maturity of lending operations with the investment horizon can limit the central bank's ability to make necessary adjustments. Fine-tuning the calibration of lending operations can improve their effectiveness and enable adjustments to targets as needed.

37 However, the scale and impact of climate-related risk for the central bank from such a programme is less clear. It reduces risks if funding is reallocated towards "green(er) assets" and these "green(er) assets are less risky. In all other cases, such a programme would increase the financial risk exposure of the central bank.

38 Evidence from the literature shows that the TLTROs adopted by the ECB stimulated bank lending to non-financial firms. Altavilla *et al.* (2023) show that the TLTROs provided a funding cost relief which had a positive impact on the lending of banks to firms. Andreeva *et al.* (2021) show that the TLTROs lead to lower reported margins on loans to relatively safe borrowers. However, these results cannot be translated one-on-one to green lending. The TLTROs were implemented in a specific economic situation, with the largest volume during the pandemic period. Furthermore, the target to increase green lending is more specific than to stimulate lending to corporates in general.

Examples

Some central banks, namely those of Japan, P.R. China, Malaysia, and Hungary, have already adopted green lending operations in their monetary policy operations (Box A2). Eligibility is based on how debtors utilise the funds raised, i.e., on the use of proceeds. Despite differing characteristics, various frameworks generally aim to provide incentives for sustainable lending by commercial banks by offering lower prices and/or longer maturities for the funding of sustainable investments and/or environmentally friendly loans under new or existing facilities. However, eligibility varies across countries, from the construction/purchase of highly energy-efficient residential real estate (Hungary) to a broader list on carbon emission reduction initiatives (Japan, China, Malaysia). Box A2 provides an overview of different frameworks.

Other central banks are still exploring the greening of their lending operations within their broader effort to integrate climate change considerations into their monetary policy frameworks. For instance, in July 2021, the ECB adopted an ambitious climate action roadmap, which includes enhancing the Eurosystem's analytical capacity, improving risk assessment, and supporting the transition to a sustainable economy while maintaining price stability (ECB, 2021a and 2021b). However, the ECB's Governing Council considered it premature to envisage green refinancing operation in the absence of a sufficiently prescriptive taxonomy, because of data limitations for sustainable economic activities and given the priority of inflation control.[39]

Box A2

Overview of Existing Central Bank Green Lending Operations

Several central banks have already begun integrating climate-related considerations into their monetary policy frameworks and non-monetary portfolios, which includes the greening of lending operations in the case of P.R. China, Hungary, Japan, and Malaysia.

In November 2021, the **People's Bank of China** (PBoC, 2021) implemented the *Carbon Emissions Reduction Facility* (CERF) as a structural monetary policy tool. This initiative allows the PBoC to offer discounted credit to commercial lenders for funding green investment projects. Prior to this, in April 2021, the PBoC had already approved green bonds and green loans as acceptable collateral for monetary policy operations. In addition, in foreign exchange reserve investment, the PBoC increased the share of green bonds, and limited investment in carbon-intensive assets.

In October 2021, the **Magyar Nemzeti Bank** (2021), the Hungarian central bank, started offering targeted and preferential refinancing funds to credit institutions which they could lend to retail clients for the construction or purchase of new, highly energy-efficient residential real estate – as part of the Hungarian Parliament's resolution of including the support of the government's policy on environmental sustainability in wider central bank mandate (May 2021).[1]

As part of its *Strategy on Climate Change*, the **Bank of Japan** (BoJ, 2021) introduced *Funds-Supplying Operations to Support Financing for Climate Change Responses* in September 2021. Borrowing financial institutions must (1) disclose a certain level of information regarding their efforts to address climate change and (2) comply with climate-related guidelines and disclosure requirements, which serve as eligibility criteria (but can freely select the allocation of lending). The BoJ does not engage in micro-level resource allocation, allowing financial institutions to respond more flexibly to firms' liquidity needs.

In February 2022, the **Bank Negara Malaysia** (2022), whose mandate includes an explicit reference to sustainable growth, launched the *Low Carbon Transition Facility* (LCTF) to support SME's transition towards low carbon and sustainable practices. Through the LCTF, eligible SMEs can obtain long-term financing of up to RM 10 million at a favourable rate.

1 The central bank introduced a comprehensive green monetary policy toolkit, which included a green mortgage-backed bond purchase programme and a green home programme (which benefits from favourable green refinancing operations). Additionally, it applies preferential haircuts for green bonds used as collateral and established a dedicated green bond portfolio as part of its foreign exchange reserve management. The macroprudential policy framework was also amended to provide preferential treatment for green mortgage-backed funding.

39 Risk-based measures, such as tilting its corporate bonds portfolio and adjusting the collateral framework to climate change, were initially prioritised over "green" lending operations. However, Colesanti Senni *et al.* (2023a and 2023b) have explored the environmental impact of TLTRO and provide the conceptual foundation for "greening" TLTRO in the future.

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