Central Bank Digital Currencies as Tools for Climate Policy: Insights from the Brazilian case

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Abstract

The severity of climate change and the important reactions at various levels and from a wide range of actors and organizations have prompted an extensive debate regarding the role that Central Banks (CBs) can play in addressing it. At the same time, there has been increasing digitalization of economic relations, including finance and money, and the creation of central bank digital currencies (CBDCs). The purpose of this paper is to discuss the role that CBs can and should play in addressing the climate crisis, integrating climate considerations not only into their regulatory, but also into their monetary policy framework. It explores how the introduction of CBDCs can contribute to that and constitute part of a broader climate policy initiative. In fact, our hypothesis is that CBDCs have the potential to amplify the reach and effectiveness of green monetary policies, particularly in processes of expanding CBs' mandates and instruments towards sustainability-oriented goals. The paper is grounded in a theoretical-institutional perspective, drawing on a heterodox political economy approach that understands money as a constitutional project and monetary design as inherently political. Due to its peculiarities and institutional development, the Brazilian case is presented as a case study of the dual movement that the paper proposes to address. Through theoretical-conceptual analysis, critical literature review, and institutional examination of the Brazilian Central Bank, we contend that CBDCs have the potential to amplify the reach and effectiveness of green monetary policies, particularly in expanding central banks' mandates towards sustainability-oriented goals. The Brazilian Digital Real case illustrates both the potential and contradictions—while its hybrid design preserves private bank intermediation, Brazil's unique combination of robust public banking and pioneering environmental credit policies creates distinctive conditions for green CBDC applications. However, the current narrow orthodox mandates focusing on price stability and inflation targeting is a political choice that prevents CBs from seizing these opportunities. This exploratory study acknowledges limitations regarding empirical data while contributing to understanding monetary innovation's potential role in climate transformation.

Introduction

Climate change, driven by increasing greenhouse gas emissions (GHG) and the rising concentration of carbon dioxide (CO2) in the atmosphere, is propelling the planet towards critical ecological thresholds, as articulated in the literature on planetary boundaries developed by

Rockström et al. (2009)[1]. The effects are already felt all over the globe: storms and hurricanes, wildfires, floods, and rising sea levels. By 2050, achieving net-zero emissions is imperative to limit global temperature rise to 1.5 to 2 degrees Celsius above pre-industrial levels, as stipulated by the Paris Agreement (IPCC, 2018). This ambitious target necessitates unprecedented efforts from governments and organizations worldwide to transition towards sustainable practices and mitigate both the direct impacts of climate change and the secondary effects of policies designed to address it.

Growing awareness of the severity of climate change has prompted important reactions at various levels and from a wide range of actors and organizations. Several initiatives in the financial sphere for coordinating and implementing measures have been put in place such as the Glasgow Financial Alliance for Net Zero, the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) and the International Development Finance Club (IDFC). Within this context, there has been extensive debate regarding the role that Central Banks (CBs) and regulatory authorities must play in addressing these questions.

The literature has been pointing out that an important bottleneck for the transition process is the huge amount of financial resources necessary to its implementation, as well as the risks to the financial system that are expected with climate changes and the transition itself (Campiglio, 2016; Dikau and Volz, 2018; Zhang, 2022; Braga and Ernst, 2023). The only way to effectively promote the necessary transition to more renewable energy sources on a global scale taking into consideration also the social impacts related to the destruction of traditional sectors of the economy and the creation of new ones - a just transition[2] - is through bold public policies which require strong and capable governments and coordination between nations.

Despite growing recognition of climate-related financial risks, in the last decades, CBs have encapsulated their mandates and considered that delivering monetary stability - mainly by adopting Inflation Targeting Regimes - is their main role (Arestis and Sawyer, 2008; Rochon, 2022). This narrowing of CBs' mandates reflects what Rochon (2022) identifies as the "weaponization of inflation" - the reduction of monetary policy to a single objective. Under this framework, monetary policy became virtually synonymous with fine-tuning short-term interest rates to reach inflation targets, while financial stability was addressed through the separate domain of prudential regulation, particularly the Basel framework's capital adequacy requirements. That effectively constrains democratic choices about economic priorities, in the sense that the policies implemented by central banks can jeopardize economic policies of elected governments. As

[1] According to the Stockholm Resilience Center, for example, six of the nine planetary boundaries have already been crossed in 2023. (https://www.stockholmresilience.org/research/planetary-boundaries.html)

[2] The concept of just transition was originally formulated in the 1970s, amid discussions between trade unionists and environmental activists. Since then, it has gained prominence, becoming a central piece of the conceptual framework that underpins the debate, as it successfully articulates the need for a transition to a low-carbon, or carbon-neutral, economy with the social dimension of human rights. According to UNECE, a just transition is an integrated approach to sustainable development that brings together social progress, workers' protection, environmental consciousness, and economic success into a framework of democratic governance and institutional support. (https://unece.org/just-transition-0)

highlighted by Eich (2022), money is inherently political. In this sense, the debate is not if money has or has not a political component, but effectively on the values and goals that should guide it.

As a response to technological as well as political changes, CBs have been incorporating the challenge of developing their digital currencies (Central Bank Digital Currencies - CBDCs), a crucial innovation that can lead to substantial changes in the monetary and financial landscape. While much attention has been focused on private cryptocurrencies, CBDCs represent a fundamentally different phenomenon: sovereign digital money that could be designed to serve public purposes, including climate objectives. Yet the intersection of CBDCs and green finance remains underexplored in both academic literature and policy discussions.

The purpose of this paper is to discuss the role of central banks in addressing the climate crisis, specifically exploring how the introduction of CBDCs can contribute to the transition process and to the enlargement of CBs' mandates and instruments to incorporate climate concerns. In order to do that, besides the introduction and conclusion, the paper has four sections. The first one presents the challenges that climate change poses to the financial system, particularly to financial stability. Section 2 presents the current mandates of central banks, price and financial stability, and how these mandates can be jeopardised by the climate crisis, and argues that they should be broadened and adapted to the new challenges. Section 3 examines how CBDCs can contribute to monetary policy toward greener objectives. Finally, the Brazilian experience is presented as a case study in section 4.

Drawing on post-keynesian monetary theory (Arestis and Sawyer, 2008; Rochon, 2022) macro-finance critiques of the New Monetary Consensus (Gabor, 2021; Kedward, Gabor and Ryan-Collins, 2024), combined with recent contributions on the political nature of money as a constitutional project (Desan, 2014; Eich, 2022), our hypothesis is that CBDCs have the potential to amplify the reach and effectiveness of green monetary policies, particularly in processes of expanding CBs' mandates and instruments towards sustainability-oriented goals. We propose that the enhanced traceability and programmability of CBDCs can increase the effectiveness of green monetary incentives by ensuring resources reach intended environmental objectives and enabling real-time monitoring of impact. The implementation of CBDCs with participatory and democratic design can contribute to expanding the monetary policy space beyond price stability, incorporating socio-environmental objectives. At the same time, the existing institutional architecture of CBs - particularly their relationship with public banks and historical experience with directed credit - shapes the political viability of green CBDC initiatives.

Our methodology combines theoretical-conceptual analysis grounded in heterodox political economy with critical literature review and comparative institutional examination. We conducted: (1) systematic literature search in Web of Science and Scopus databases (2015-2025) using keywords "CBDC", "green finance", "climate change", and "monetary policy"; (2) document analysis of reports from the Network for Greening the Financial System (NGFS), Bank for International Settlements (BIS), and national CBs; (3) in-depth examination of Brazil, justified by its unique combination of robust public banking, advanced CBDC development (Digital Real), and pioneering environmental credit regulations since 2008. This exploratory study acknowledges

limitations regarding the absence of operational green CBDCs and the rapidly evolving nature of both climate policy and digital currency development.

1. Climate change and risks to the financial system

At the present, the primary concerns of CBs and regulatory authorities are price and financial stability. These goals can be jeopardized by climate changes which impose a new set of risks - both physical and transition ones. These risks are significant enough to cause major market disruptions, highlighting the need for early and coordinated actions to manage the transition effectively and avoid amplifying financial instability[3].

Physical risks stem from the impacts of changing climatic conditions, which can be assessed through both their direct and indirect effects. These risks are evidenced by the increasing frequency and severity of extreme weather events - such as storms, floods, heatwaves, and wildfires, as well as through broader shifts in climate patterns, including changes in precipitation and rising sea levels. Such events can lead to significant losses in human lives, damage to natural and urban environments, and significant disruptions to businesses. The destruction of physical capital and the decline in profitability for firms, coupled with reduction in household incomes, can lead to a reallocation of financial assets, resulting in significant negative wealth effects.

These wealth effects may, through second-round consequences, place additional pressure on demand and prices, exacerbating the adverse economic and financial impacts. As losses accumulate, firms and households may face difficulties in meeting their debt obligations, and collateral values may deteriorate, leading to heightened exposure to financial risk. Insurance liabilities may also increase due to the rising costs of claims. As a result, financial institutions may experience capital shortages that impair their ability to absorb losses and potentially triggering contagion effects that could lead to widespread asset devaluations throughout the financial system (Giuzio et al., 2019). The Bank for International Settlements (BIS, 2021) warns that physical risks pose a threat to financial stability by generating irreversible losses, as both physical and financial capitals are affected by climate shocks, leaving financial institutions vulnerable and often unable to protect themselves against such risks. The inability to mitigate these climate-induced financial shocks underscores the systemic nature of physical risks and their capacity to disrupt financial systems (Giuzio et al., 2019; BIS, 2021; D'Orazio and Popoyan, 2022).

Transition risks emerge from the transformation towards a low-carbon economy and carry unpredictable financial consequences. These risks materialize when mitigation strategies such as policies, technological advances, or swings in public perception, are implemented, leading to abrupt revaluations of assets, particularly if the transition occurs suddenly. Unanticipated introduction of greening policies or significant changes in consumer preferences can trigger abrupt decline in asset prices tied to carbon-intensive industries and sectors (Giuzio et al, 2019).

[3] While Minsky's original theory of financial instability emphasizes the inherent fragility of the financial system, Carney's analogy underscores the potential magnitude of climate-related disruptions. The risks are significant enough to prompt major market dislocations, similar to the crises described by Minsky. Such risks reinforce the need for early and coordinated actions to ensure a smoother transition and mitigate the risks of exacerbating financial instability.

Transition risks are associated with various factors, including the introduction of environmental legislation, the obsolescence of polluting industries, changes in policies, reputational effects, technological advancements or constraints, and alterations in market preferences and societal norms (Carney, 2018; BIS, 2021). The unpredictability of these changes can cause substantial disruptions in financial markets leading to sharp reallocations of capital from "brown" (high-carbon) to "green" (low-carbon) assets, driven by market repricing of risks and efforts to mitigate reputational and legal liabilities.

CBs and regulatory authorities may inadvertently contribute to or exacerbate these market disruptions, particularly in credit markets (Campiglio, 2016). The rapid shift away from carbon-intensive activities could lead to an intensification of financial instability. As Carney (2016) pointed out, this paradox of transition risks highlights that the more successful the strategies for mitigating climate change, the more severe the financial disruptions associated with the transition can become - what he terms as "success is failure".

BIS (2021) outlines five key pathways through which climate-related risks can turn into financial risks, each capable of threatening the stability of the financial system. Firstly, credit risk arises as climate-related disruptions undermine borrowers' ability to repay their debts. Extreme weather events can result in capital destruction, lower business profitability, and reduced household incomes, which in turn negatively affect borrowers' capacity to meet their financial obligations. In a similar way, transition risks can lead to a sharp decline in the value of carbon-intensive assets, increasing the chance of defaults. Furthermore, collaterals used to secure loans may also lose value in sectors vulnerable to climate impacts, thereby compounding the credit risk.

Secondly, market risk occurs when sudden changes in investor sentiment regarding climate risks lead to heightened market volatility. A rapid shift towards a low-carbon economy could cause a significant drop in the value of "brown" assets, leading to investor sell-offs at discounted prices. This process, known as fire sales, can trigger broader disruptions in the financial markets, as the revaluation of assets spreads across various sectors, generating instability.

Thirdly, insurance risk is closely tied to the increasing occurrence of extreme weather events due to climate change. As these events become more frequent and severe, the costs of insurance claims rise, placing financial strain on insurers. If insurers find it difficult to meet these rising costs, it could lead to solvency issues, potentially threatening the stability of the entire insurance sector. The impacts could spillover into the broader financial system, particularly in regions heavily dependent on insurance to mitigate risks.

Fourthly, liquidity risk emerges when the repricing of assets in response to climate risks leads to a sudden withdrawal of liquidity. Companies and financial institutions with significant exposure to climate-sensitive sectors may face difficulties in obtaining financing, as investors and lenders become more cautious. This reduced liquidity can exacerbate financial stress, further destabilizing the markets. Lastly, operational risk becomes a concern as climate-related events disrupt the day-to-day operations of financial institutions. Additionally, regulations aimed at addressing climate risks may impose new compliance costs, which can put further pressure on institutions' operational capacities.

Together, these pathways illustrate the varied and interconnected ways in which climate-related risks can infiltrate the financial system. However, integrating climate-related risks into regulatory and financial frameworks as they currently stand presents significant challenges. Traditional risk management relies heavily on historical data and assumes that shocks are normally distributed. This is particularly problematic in the context of climate change, where risks are inherently unpredictable, and historical patterns fail to capture the potential severity of future events.

2. Central Banks' mandates and climate change

Traditionally, the CB's financial stability mandate imposes reactions once financial instability sets in and leads to a financial crisis. These authorities have no choice but to act as lenders of last resort in the quest to tackle and re-establish financial stability. Climate events may force central banks to act as "climate rescuers of last resort" (Bolton et al, 2020) and avoid further devaluation of assets and try to restore the financial system. Yet, the challenge here is different - climate-related crises may have continuous, irreversible impacts, making the stabilization efforts more complex and the typical interventions less effective.

Villeroy de Galhau, former Governor of the Banque de France, affirms that climate risks can not only threaten CBs' mandates of price and financial stability, but also our socio-economic systems. As he notes, climate changes can impose non-linear and irreversible financial losses and the required economic transition to address them can affect "every single agent in the economy and every single asset price" (BIS, 2021, p. viii). Given this broad spectrum of challenges, CBs have a crucial role in coordinating efforts across various sectors, including governments, the private sector, and civil society. As BIS General Manager Agustín Carstens argues, this coordination role aligns with CB's mandates and could contribute to better assessing and monitoring climate-related risks. CBs can also help develop and assess green and brown taxonomies, ensuring that the regulatory responses are well-tailored to the emerging risks. Moreover, they can enhance prudential regulations that address the financial stability threats posed by climate change (BIS, 2021).

However, there is not a consensus on how to integrate climate risks into monetary policy, which remains central to controlling inflation and maintaining price stability. Some argue that CBs should not adopt "green targets" within their mandates, suggesting that fiscal and regulatory measures might be more efficient in addressing climate risks. They point out that climate change complicates CBs' traditional role of price stability, and "the last thing they need is to feel pressure to load additional objectives on their limited instruments" (Buiter, 2021, p. 1). From this perspective, CBs should focus on responding to the fragile economic and inflationary contexts created by climate change, rather than actively pursuing the transition to a low-carbon economy.

Others defend that the price stability mandates can be jeopardized by climate change and that CBs should take their part in the transition to low-carbon economies. Though acknowledging that this could lead to an overburdening of CBs' existing mandates, they argue CBs must be part

of a broader range of interventions, including fiscal and regulatory actions (BIS, 2021). According to Galhau (2019, p. 10-12), this recognition could push CBs to consider whether they should take preventive action to join efforts aimed at limiting global warming and thus adopt an approach of "leaning against climate change". As he argues, "monetary policy is also involved in this collective mobilization […] thoroughly integrating climate change into the monetary policy framework".

The climate-related risks analyzed above materialize as economic shocks when extreme weather events occur or transition policies are implemented. Climate related events can and do have direct impact on agricultural and food products and on energy, creating inflationary pressures through supply-side disruptions (damaged infrastructure, reduced agricultural output) and demand-side impacts (wealth effects, changing consumption patterns). Extreme weather conditions have a broader impact on infrastructure, buildings, the health of employees and productivity, and consequently production and price structures, which can happen through supply-side and demand-side shocks (Galhau, 2019; BIS, 2021). So, climate-related events are likely to affect price stability mandates and even the traditional policy instruments, which can be less effective at smoothing these shocks, as they are enduring biophysical shocks, rather than transitory economic shocks. The recognition that climate shocks create supply-side inflation challenges the effectiveness of traditional demand-management tools, reinforcing the need for alternative instruments that can address the structural transformation required by the climate transition.

One can see that the arguments are wide-ranging. Dikau and Volz (2018) state that a potential "green central bank" may, first, be concerned with climate change as it poses threats to their current mandates of financial and macroeconomic stability.[4] In this case, CBs would only respond in a "passive" way; climate change would not be an explicit concern. Kedward, Gabor and Ryan-Collins (2024), in a similar way, call this a "risk-based approach" for the CB, one that "stresses 'fixing' market signals, both by enhancing price discovery and by steering green/dirty credit and asset prices (derisking)". This is the dominant model and a structural unfolding of the macro-financial status-quo, which involves information-based measures - such as disclosure of climate-risk and stress tests - and reinforces the power of private finance as the best decision maker when it comes to the allocation of resources. DiLeo et al (2023), distincting three different climate approaches to CBs' policies, call this "Foundational norms – no evolution from basic Central Bank Independence (CBI) norms". There is no change to the mandate or instruments, and the CB only integrates climate change to the extent that it can affect the financial system.

There are, however, other possibilities. One is what Dikau and Volz (2018) call an "activist" CB, which would have in its mandate promoting green investments using the tools it currently has. Kedward, Gabor and Ryan-Collins (2024) refer in a similar way to an "allocative green credit policy"- which they support - that requires a "revival of credit policy" in order to allow the monetary authority discretion in the selection of sectors to be incentivized or not and/or in the use of more coercitive tools to steer credit. DiLeo et al. (2023) similarly put two other alternatives: a

[4] The incorporation of green instruments, such as green bonds, into the monetary policy framework could represent a means of stimulating their issuance and contribute to alignment of monetary policy with environmental objectives. That represents an important dimension of the broad discussion on "green monetary policy". In spite of that, it will not be developed here, but can be incorporated in future research.

CB with “proactive norms” that would take into consideration the challenges posed by climate change on monetary policy and regulation of financial institutions, but still not taking further action to steer the economy into a “greener” direction. The second possibility for the authors would be a “reformist” CB, using credit policies to really support a green/just transition.

Going a little further, in our view a truly “democratic central bank” (Deos e Ultremare, 2024) is one that can effectively help societies face the huge challenges that lie ahead. It is crucial to transform central banking, meaning the political and technical management of money and credit, in order to serve the majority of society. Read through the lens of Dardot and Laval’s (2014) political principle of the common, this democratising horizon involves reinstituting money and credit as objects of collective deliberation and shared obligation, beyond the binary of state command and market allocation that has structured monetary governance under neoliberalism. The idea would be not only to mitigate the financial risks, but even more comprehensively, incorporating credit policies to tackle climate change using CBDCs as we will discuss in the third section. It is important to note that this wouldn’t be a total novelty in terms of CBs’ mandates, since it was a relatively standard approach in the 1950s and 1960s. Tools to influence credit allocation were common in the post-War period, such as: i. differentiating interest and discount rates according to the sector (an example would be the Bundesbank in 1973 excluding export credit from tighter interest rates); ii. specific agencies that lend with lower rates to strategic sectors; iii. direct credit from the central bank to firms and local governments; iv. discount window guidance; v. clear guidelines for banks to lend to certain sectors; and vi. indirect instruments that work as price signals such as preferential refinancing terms, capital and reserve requirements, and government subsidies (Monnet and van ’t Klooster, 2023).

In this sense, the idea that monetary policy needs to have one goal - price stability - and one instrument - the short-term interest rate - was not always the norm. Much to the contrary. Throughout their history, CBs have transformed and adapted to the challenges of their times. The Great Depression and then WWII, for instance, brought a need for CBs (and especially the Federal Reserve) to reinvent themselves from being mostly lenders of last resort operating in the discount window to become more proactive, using the open market instrument and controlling interest rates (Deos e Ultremare, 2024). By the 1970s, higher global inflation sparked yet again a review in the operational framework for monetary policy following the Monetarist school’s prescription to control money supply. The disastrous effects of this experience left, however, an inheritance: price stability became the main goal in CBs’ mandates. The so-called New Monetary Consensus (NMC) rose as the dominant school of economic thought for monetary policy in the late 1980s, influencing virtually all large CBs in the world to adopt either a formal or informal inflation targeting regime in their mandates. Fiscal policy was transformed into an accessory of monetary policy in a regime of monetary dominance (Kedward, Gabor and Ryan-Collins, 2024), where the government spending is marked by austerity, limited and dependent on funding with market instruments.

The 2008 global financial crisis (GFC) and its impacts on financial systems obligated CBs to respond quickly to manage both financial and economic instabilities. For that, they used the traditional instrument of short-term interest rates but also created new tools - which came to be

known as non-conventional monetary policies - to stabilize the financial system. Despite changes in their operational framework - the Fed, for example, moved from overnight open market operations to paying interest on excess reserves to control the short-term interest rate - CBs' mandates have changed little from what the NMC prescribes. The current setup is still the same: CBs have a mandate and enjoy operational autonomy, or independence, to pursue economic stability (for most CBs, this still means only price stability) and financial stability with prudential regulation and lender of last resort tools. This framework is not one equipped to deal with the kind of issues that arise with climate change, even if one takes in consideration only the issue of price stability. As Schroeder (2023) points out, the instruments CBs have today were designed to impact a *demand-driven* inflation, when climate change will provoke *supply-side* inflation, much like after the pandemic, but with much longer-term impacts.

Nonetheless, it is important to note that the ways CBs responded to the emergency brought on by the GFC, and then more recently by the COVID-19 pandemic, show us that CBs can adapt and innovate when the circumstances demand them to: *"history reminds us that central banks – even independent ones – have not hesitated to give priority to certain loans when they felt that it was absolutely necessary for the economy"* (Monnet and van 't Klooster, 2023, p. 12). The climate crisis is already an emergency, but so far CBs' responses have been weak.

The limitations of current CBs mandates and instruments highlighted above open space for considering how CBDCs might enable new forms of monetary governance more adequate to the climate emergency. Rather than viewing CBDCs merely as technological upgrades to existing payment systems, we argue they represent opportunities to reimagine CB's mandates and instruments. While maintaining awareness that technical choices embed political decisions about monetary power (Desan, 2014), our specific focus here is on how CBDCs can contribute to operationalizing environmental objectives within monetary policy frameworks, transforming CBs from passive observers of climate risks into active agents of sustainable transformation.

3. Can CBDCs be an instrument to tackle climate change?

This section examines how CBDCs can contribute to monetary policy toward greener objectives. Drawing on heterodox political economy perspectives, we argue that CBDCs can revive monetary allocation tools that were central to post-war economic management. They were abandoned under neoliberal influence after the 1970s, and CBDCs offer opportunities to reimagine these frameworks for contemporary use.

CBDCs have fundamental characteristics as sovereign digital money. Unlike private cryptocurrencies driven by speculative dynamics, CBDCs represent direct claims on central banks, carrying the full trust of sovereign states (Bindseil, 2019, 2020; Brooks, 2021). This sovereign backing provides the foundation for their potential use as policy instruments beyond simple payment facilitation.

In the current monetary system, CBs' liabilities assume two formats: *physical* cash, which are in part in use by the public in transactions and in part sitting in banks' vaults, and *electronic* money (bank reserves) which serve mainly the purpose of settling interbank transactions, not available to the general public. Only banks (and other financial institutions authorized to do so) have a reserve account with the CB, where reserve balances are kept.

CBDCs have the potential to fundamentally alter this architecture by extending access to central bank electronic money beyond the financial sector, creating what Dyson and Hodgson (2016) term "digital cash for all". However, as the literature (Desan 2014, Eich 2022; Pistor, 2017) emphasizes, this is not merely about access but about the power to create money itself. Currently, private banks create the majority of money supply through deposit creation when making loans - deposits that function as private money circulating at par with state money (Keynes, 1930; Mehrling, 2013; Carvalho, 1999). As Mehrling (2013) shows, monetary systems are inherently hierarchical: promises to pay at one level (bank deposits) function as means of payment at the level below, while themselves being mere credit relative to the level above (central bank reserves). Carvalho (1999, 2015) adds the indispensable behavioural dimension: banks are not passive accommodators of credit demand but portfolio managers with active liquidity preferences, whose decisions on the composition of their assets determine whether credit flows toward what Keynes called the "industrial circulation" or remains trapped in the "financial circulation". This conceptual apparatus is decisive for assessing what CBDCs can and cannot accomplish: technical access to central bank money does not, by itself, reconfigure the hierarchy or alter banks' liquidity preference, which is precisely what most green-CBDC proposals tacitly assume.CBDCs could potentially disrupt this two-tier monetary system and the associated privilege of private money creation, with profound implications for monetary policy transmission and financial power structures.

The specific design of CBDCs remains under discussion. Regarding availability, a 'wholesale' CBDC would only be accessible to banks and financial institutions, whereas a 'retail' CBDC would serve transactions for all customers, with or without limits on holdings. Concerning format, a 'direct' CBDC would involve the central bank issuing currency and performing all functions including account management. In a 'hybrid' or 'intermediated' CBDC, the central bank issues the currency but delegates some functions to intermediaries like banks, without direct interaction with end customers. The choice between these models reflects deeper political economy considerations about the role of private banks in money creation and the extent of democratic control over monetary systems (Kedward et al., 2024).

For the technology involved, the main design issue is deciding whether the CBDC will be account-based, where the user identity is validated (similar to bank deposit transfers), or token-based, where the transaction itself is validated, protecting user privacy. Another crucial consideration is the infrastructure for clearing and validating payments - whether to employ Distributed Ledger Technology (DLT) like blockchain or centralized conventional systems currently used by central banks. These technological choices embed political decisions about surveillance, privacy, and state power.

Following Desan's (2014) analysis of money as a constitutional project, the design choices embedded in CBDCs represent fundamental political decisions about who has access to the sovereign's monetary liabilities and under what conditions - choices that can either reinforce or challenge existing power structures in the monetary system. Eich (2022) extends this analysis, arguing that monetary architectures embed specific visions of democratic governance and economic justice. These theoretical insights become particularly salient when considering how CBDCs might channel resources toward climate objectives in what would be a "green CBDC" - each design decision carries implications for the distribution of monetary power, environmental effectiveness, social equity, and democratic control.

3.1 CBDCs: Potential applications for Climate Change

The potential applications of CBDCs for climate finance can be understood through several distinct yet complementary mechanisms that demonstrate how CBDCs could fundamentally reconstitute what Desan (2014) identifies as money's constitutional role - mobilising the sovereign's constitutional capacity to determine what counts as money and on what terms it circulates, in order to systematically channel resources toward green activities while raising the cost of credit for brown sectors. This transcends the "allocative green credit policy" advocated by Kedward et al. (2024), representing instead a reimagination of money as "a mode of governance" that actively structures economic activity (Desan, 2014, p. 6). Green CBDCs could transform money from an instrument that obscures its distributional politics into one that openly advances democratic ecological objectives through the sovereign's unique capacity to define the medium of tax payment and legal settlement.

First, central banks could issue CBDCs to financial institutions using smart contracts, with embedded conditionalities ensuring green lending. This mechanism would represent a digital version of the directed credit policies that were commonplace in post-war monetary management, when central banks routinely channeled credit toward strategic sectors deemed essential for reconstruction and development (Monnet and van't Klooster, 2023). Smart contracts would theoretically guarantee that funds flow exclusively to verified green projects, with real-time monitoring replacing the bureaucratic oversight that characterized earlier credit allocation systems. The Bank for International Settlements' Project Genesis 2.0 (BIS, 2022) provides preliminary evidence of technical feasibility, demonstrating how smart contracts can link green bond issuance with automated carbon credit verification. The CB could potentially issue CBDCs that would be allocated to green investments with funds released after certain environmental criteria and milestones are met. The programmability of CBDCs distinguishes them from existing forms of money and creates novel possibilities for environmental policy integration. Smart contracts embedded in CBDC infrastructure can automate compliance with environmental criteria, ensure funds reach intended recipients, and create self-executing green finance mechanisms (Auer et al., 2020). This programmability enables what the established literature calls "programmable money"

– currency with built-in conditionalities designed to achieve specific social and environmental objectives while maintaining its general medium of exchange function (Bech and Garratt, 2017)

Second, CBs could experiment with "carbon-aware CBDCs" (building on proposals by Van Gansbeke, 2021; and theoretical frameworks outlined by Náñez Alonso, 2023), wherein carbon accounting would be embedded directly into the monetary infrastructure. Each CBDC unit would carry metadata tracking its carbon footprint through transaction chains, creating what might be termed "carbon-weighted money". Unlike external carbon pricing mechanisms that operate through market signals, carbon-integrated CBDCs would attempt to make environmental costs intrinsic to monetary transactions themselves. This approach purports to transcend traditional Pigouvian taxation by making carbon costs immediate and transparent at the point of transaction. Consumers using CBDCs for high-carbon purchases would face automatic surcharges, while low-carbon transactions could receive rebates - all executed through smart contracts without additional bureaucratic infrastructure. This pathway, however, is qualitatively more problematic than the directed-credit and green refinancing routes discussed above. It presupposes the possibility of attributing a stable and verifiable carbon footprint to each unit of currency along the entire transaction chain, which reproduces the well-documented limitations of cap-and-trade and offset markets (counterfactual problems, leakage, double counting, dependence on private auditors). It also risks displacing political responsibility for the transition onto individual consumption choices, reframing systemic transformation as a question of personal carbon accounting (Mader and Duvendack, 2025). For these reasons, we treat "carbon-aware CBDCs" not as one option among others but as the design pathway most exposed to the depoliticisation we criticise in section 3.2, and we emphasise instead the institutional routes of directed credit and green refinancing as the more defensible expressions of an allocative green CBDC strategy.

A third pathway involves what Ozili (2022, 2023) conceptualizes as programmable CBDCs designed to incentivize circular economy practices through innovative monetary design. This mechanism would leverage CBDCs' programmability to create currencies with specific validity parameters - expiration dates to encourage rapid circulation, geographic restrictions to support local economies, or sector-specific validity to channel spending toward sustainable industries. One example could be "green stimulus CBDCs" programmed to expire if not spent on verified sustainable goods and services within specified timeframes, creating what proponents argue powerful incentives for green consumption without relying on individual environmental consciousness. Geographic programming could theoretically ensure that climate adaptation funds remain in vulnerable communities rather than leaking to financial centers, potentially addressing the spatial inequalities that characterize current climate finance.

Fourth, and perhaps most radical, rather than purchasing existing financial assets as in conventional quantitative easing, CBs could create CBDCs specifically for environmental investment, potentially at negative interest rates for verified climate projects (Van Gansbeke, 2021; Klooster and Tilburg, 2020; Dafermos, Nikolaidi and Galanis, 2018). This mechanism would bypass financial sector intermediation, directly funding the real economy's green transformation. This approach directly responds to the well-documented critique that conventional QE inflates

asset prices without reaching productive investment (Kedward et al., 2024; Dafermos et al., 2021). Green CBDC facilities could provide patient capital for long-term climate infrastructure, fund community renewable energy projects, or capitalize green development banks - all while claiming to maintain democratic oversight through transparent blockchain records. The negative interest rates possible with CBDCs would theoretically enable more aggressive climate financing than current monetary frameworks permit.

The conspicuous absence of operational green CBDCs globally reveals the gap between technical possibility and political reality. Current CBDC designs overwhelmingly reproduce attempts to depoliticize monetary policy by treating digital currency as neutral technical infrastructure rather than recognizing it as an opportunity to reimagine CBs' mandates and instruments. The pathways outlined above could either reinforce market-based "solutions" that maintain underlying expansionary dynamics, or enable genuine alternatives - but only if we recognize that monetary architecture inherently embeds political choices about how society relates to nature. The fact that no CB has yet incorporated explicit environmental objectives into CBDC design suggests that without challenging the primacy of price stability as their main mandate, digital currencies will merely digitalize existing patterns of ecological destruction rather than transform them.

3.2 Risks, Limitations, and the Democratic Imperative

While CBDCs offer promising avenues for climate action, their transformative potential remains circumscribed by fundamental contradictions inherent in contemporary monetary governance. Following Desan's (2014) insight that monetary design constitutes a political project of distributing economic agency, we must recognize that several risks emerge not merely as technical challenges but as manifestations of deeper political tensions that must be acknowledged and addressed through democratic institutional design. These risks, highlighted above, reveal how the depoliticization of monetary policy under neoliberalism creates structural barriers for mobilizing CBDCs for ecological transformation.

First, enhanced traceability raises fundamental questions about monetary sovereignty and individual autonomy. The programmability enabling environmental conditionalities simultaneously creates unprecedented state capacity for economic surveillance. As Eich (2022) argues, monetary architectures embed political choices about democratic governance. In CBDCs, these choices become crystallized in code—the same programmability that could democratize green finance by ensuring resources reach environmental objectives could equally enable pervasive economic surveillance. The distinction between climate tool and control mechanism lies not in the technology itself but in the democratic frameworks—or their absence—governing its deployment.

Second, disintermediation risks reveal how current CBDC designs protect rather than challenge existing monetary hierarchies. By requiring that citizens access CBDCs through banks rather than holding direct accounts with the central bank, this design maintains banks' power over

credit creation – what post-Keynesians identify as the source of most money in modern economies. This institutional conservatism limits CBDCs' capacity to resurrect the directed credit mechanisms that Monnet and van't Klooster (2023) document as historically effective for strategic economic transformation.

Third, international coordination challenges expose the hierarchical nature of global monetary relations. Without addressing structural asymmetries in the international monetary system, particularly developing countries' currency constraints, green CBDCs risk reproducing rather than transforming North-South inequalities. The post-Keynesian and structuralist literature on international currency hierarchies (Kaltenbrunner, 2015; Prates, 2020; Bonizzi, Kaltenbrunner and Powell, 2019; De Conti, Prates and Plíhon, 2014) shows that the liquidity premium of peripheral currencies is endogenously inferior to that of the dollar and other key reserve currencies, which structurally constrains the policy space of subordinate central banks. A green CBDC issued by a peripheral central bank therefore operates under conditions qualitatively different from one issued by the Fed or the ECB: its operational scope depends on global dealers' willingness to market-make in that currency, on capital-flow management capacity, and on the absence of green conditionalities imposed from the core. Recent work by Löscher and Kaltenbrunner (2025) and Gabor and Sylla (2023) underscores that climate finance architectures designed in the core risk reproducing rather than transforming these asymmetries, recasting old forms of conditionality in green vocabulary. The absence of multilateral frameworks for climate finance through CBDCs reflects what Gabor (2021) identifies as the subordination of developmental and environmental objectives to global financial market imperatives, potentially creating new forms of green conditionality that perpetuate dependency rather than enabling autonomous sustainable development.

Fourth, the emphasis on technological solutions obscures fundamental questions about monetary democratization. This technological barrier transforms what should be a tool for inclusive green finance into another mechanism of exclusion. Simultaneously, the discourse celebrating blockchain's technical features masks the political economy question: whether CBDCs will democratize monetary power or simply digitalize existing hierarchies. This technological determinism serves to depoliticize fundamental choices about economic organization, reducing climate finance to coding problems rather than recognizing it as democratic contestation over resource allocation.

4. The Brazilian case: a critical analysis

According to Dikau and Ryan-Collins (2017), in emerging markets and developing economies (EMDCs), CBs have a wider mandate to support development and the government's economic policy agenda. If that can be the case for other countries that fit into the EMDCs scope, this is not the case in Brazil. Paradoxically, despite possessing robust public banking infrastructure historically oriented toward development, the Brazilian Central Bank (BCB) has voluntarily adopted one of the most restrictive mandates among emerging economies. Since 1999, the BCB

has committed to a narrow inflation targeting mandate. More recently, in 2021, reinforcing this direction, the BCB formal autonomy was established with the fundamental objective of reaching the inflation target and, ranked secondly and without prejudice of the fundamental goal, fostering the stability and efficiency of the financial system, smoothing fluctuations in the level of economic activity, and promoting full employment. In a further development of this institutional design, as of January 2025 the Brazilian regime moved from a calendar-year to a continuous inflation targeting framework (CMN Resolution of June 2024), with a 3% target and a 1.5 percentage-point tolerance band assessed on a rolling twelve-month basis. The shift consolidates rather than relaxes the centrality of price stability, since target revisions now require a 36-month lead time, further insulating monetary policy from short-term democratic deliberation.

It is however crucial to highlight that the Brazilian financial system comprises an important group of public banks that many times in the past, and even more recently - in order to face the 2008 crisis effects - have performed as "arms" of the BCB (Deos and Mendonça, 2017). Brazil's credit policies differ fundamentally from the European approach, for example. While European credit policies operate within the monetary policy framework, Brazil employs an institutional framework. This framework relies on both public banks and credit guidance mechanisms. It offers particularly important insights for understanding how emerging economies navigate the tensions between orthodox monetary frameworks and developmental imperatives. Unlike the Northern CBs, the BCB operates in a context marked by structural heterogeneity, external vulnerability, and pressing social demands that make purely technocratic approaches to monetary policy politically unsustainable. The presence of robust public banking institutions and a credit guidance framework - including the Brazilian Development Bank (BNDES), Banco do Brasil, and Caixa Econômica Federal - creates unique institutional possibilities for green finance that are absent in more market-dominated financial systems.

This public banking infrastructure and credit guidance mechanisms have historically served as a transmission mechanism for developmental policies, allowing the Brazilian State to direct credit toward strategic sectors even when the BCB maintains orthodox monetary policy orientation. During the 2008 global financial crisis, for instance, while private banks credit contracted, public banks expanded credit counter-cyclically, effectively implementing expansionary credit policy despite restrictive monetary conditions. This experience demonstrates not merely counter-cyclical capacity but the persistence of what Kedward et al. (2024) term "allocative credit policy" - the ability to direct credit toward specific objectives despite restrictive monetary conditions. For green CBDCs, this institutional precedent suggests that Brazil's existing public banking infrastructure could operationalize environmental credit policies even within the formal constraints of inflation targeting.

It is worth noting that in Brazil, already in 2008, the National Monetary Council (NMC) introduced resolutions requiring financial institutions and rural producers to have proof of compliance with environmental regulations to access subsidized rural credit. The measure, aimed at restricting credit for those who infringed environmental regulations, applied to all establishments in municipalities located entirely within the Amazon biome. This early experience

establishes the regulatory precedent and institutional capacity that programmable CBDCs could transform into sophisticated, automated mechanisms - evolving from binary compliance checks to the continuous environmental monitoring and dynamic incentives we conceptualized in Section 3 as "carbon-aware CBDCs".

This pioneering environmental credit regulation demonstrates Brazil's capacity for institutional innovation despite formal adherence to orthodox monetary frameworks. The resolution effectively created a form of "green conditionality" for agricultural credit - a mechanism that could be significantly enhanced through CBDC programmability as discussed in section 3. This early experience provides valuable lessons: first, that environmental objectives can be integrated into credit systems; second, that enforcement mechanisms matter for effectiveness; and third, that political economy considerations shape implementation. The agricultural lobby's resistance to these measures reveals the power dynamics that any green central banking initiative would need to navigate.

In 2017, the BCB implemented its Policy for Socio-Environmental Responsibility (PRSA), which was updated in mid-2024 , becoming the Social, Environmental, and Climate Responsibility Policy (PRSAC). The goal was to improve the governance structure for its implementation and monitoring. Among the guidelines provided by the Resolution is that the BCB has to promote actions so that the financial and payment systems can increasingly contribute to sustainable economic development meaning, for instance, to consider the implementation of social, environmental, and climate responsibility policies in the scope of the Bank supervision of financial institutions and other institutions.

In 2020, the BCB launched the Sustainability dimension in its strategic Agenda, (https://www.bcb.gov.br/en/about/bcbhashtag) and since then it has been a supporter of the international Task Force on Climate-related Financial Disclosures (TCFD), created in 2015 by the Financial Stability Board (FSB). In 2021, the BCB implemented several key initiatives: improved regulations on socio-environmental risks, enhanced information disclosure requirements for financial institutions, and the establishment of the Green Bureau of Rural Credit. These changes were accompanied by a series of norms approved by the NMC. In 2022, regulatory actions were introduced to adjust the accounting registration of sustainability assets. Lastly, the BCB is developing models aimed at tackling climate concerns, focusing on stress tests scenarios that can affect financial stability, as well as adapting its main macro model to incorporate not only the impact of climate change, but also of policies fostering the transition.

However, despite its relatively early incorporation of "sustainability issues etc" in its agenda, up to the moment the BCB has no proposition in terms of monetary policies to address climate changes. The contrast between Brazil's pioneering environmental credit regulations and its conservative monetary policy orientation illustrates the political tensions inherent in central banking. While the BCB has shown innovation in using regulatory tools for environmental purposes, its adherence to inflation targeting orthodoxy constrains the potential for more transformative monetary interventions.

Brazil's approach to CBDC development offers crucial insights into both the potential and limitations of green digital currencies in emerging economies. The country's unique combination of robust public banking infrastructure and credit guidance mechanisms, pioneering environmental credit regulations since 2008, and advanced digital payment systems creates distinctive conditions for implementing green CBDCs that differ markedly from Northern models. Yet, as we argue below, these favorable conditions remain constrained by the political economy of orthodox monetary governance.

The proposed model for the Digital Real exemplifies what might be characterized as institutional conservatism masked as innovation. The BCB has designed its CBDC as a hybrid model that preserves the established two-tier monetary structure, with the BCB issuing the currency while access is provided by custodians within the existing payment system (BCB, 2024). This design choice reveals how political economy constraints shape technological possibilities - the perceived need to maintain financial stability and international credibility effectively forecloses more transformative monetary architectures that could challenge private banking privileges (Deos and Ultremare, 2024).

The success of Pix, Brazil's instant payment system launched in 2020, provides crucial context for understanding the potential of the Digital Real. Within two years, Pix achieved over 130 million users - approximately 60% of Brazil's population - processing billions of transactions monthly (BCB, 2025). This rapid adoption demonstrates several key factors: the BC's technical capacity to implement large-scale digital infrastructure; the population's readiness to embrace digital financial innovations; and the potential for public digital infrastructure to achieve financial inclusion objectives that market-based solutions failed to deliver. Pix's architecture - which allows direct central bank settlement for retail transactions - creates a technical and social foundation that could facilitate the Digital Real's implementation for green finance purposes.

The Digital Real pilot project, launched in 2023, involves 16 financial institutions including major public and private banks, payment institutions, and infrastructure providers. The technological architecture - Hyperledger Besu, a private blockchain platform - reflects a choice prioritizing state control and privacy over the transparency and distributed governance that public blockchains could offer. Most revealing, however, is what the pilot excludes: despite Brazil's pioneering environmental credit regulations dating to 2008 and its urgent climate vulnerabilities, the Digital Real contains no explicit green finance applications. This absence is not only technical but mostly a political choice, revealing how orthodox monetary frameworks actively prevent the mobilization of monetary sovereignty for ecological objectives.

The trajectory of the Drex pilot itself reinforces this diagnosis. In November 2025, the BCB announced the discontinuation of the Hyperledger Besu-based platform, citing the impossibility of reconciling the privacy requirements of financial transactions with the centralized control architecture demanded by the regulator. A new phase, planned for 2026, is to begin by defining use cases before selecting the underlying technology, with the BCB adopting an explicitly "technology-agnostic" stance and a substantially narrower scope focused on tokenized asset settlement and collateralized lending rather than a retail digital real. Crucially, the failure of Drex

1.0 was not driven by democratic pressure to incorporate socio-environmental objectives, but by an unresolved technical-political tension between market-oriented privacy (banking secrecy, competitive opacity among custodians) and centralized regulatory control. The contradiction this paper identifies between institutional capacity and orthodox mandate thus materialized empirically: when forced to choose, the BCB prioritized interoperability and asset tokenization over any redistributive or ecological reorientation of monetary architecture. The Brazilian experience confirms that programmability alone, absent a reconstitution of the political project of money, does not democratize monetary governance.

Brazil's Pix system provides important context for understanding both possibilities and limitations. Achieving over 130 million users within two years, Pix demonstrates not merely "social readiness" for digital innovation but the state's capacity to create monetary infrastructure that serves public purposes when political will exists (BCB, 2024). The technical and institutional infrastructure developed for Pix - digital identity systems, regulatory frameworks, user interfaces - could readily support green CBDC implementation. Moreover, Brazil's public banks possess decades of experience with directed credit for developmental purposes, representing accumulated institutional knowledge that orthodox monetary policy deliberately sidelines rather than mobilizes for climate transition.

Araújo (2022) optimistically suggests that the Digital Real will advance digital inclusion through smart contract functionality, building on Pix's foundation. While the incorporation of programmable features could theoretically enhance efficiency for underserved populations, this techno-optimism obscures how financial exclusion stems from structural inequalities that technical solutions alone cannot address. The question is not whether smart contracts can reach the unbanked, but whether monetary policy will be democratized to serve their needs rather than capital accumulation imperatives.

The fundamental contradiction emerges clearly: Brazil possesses the institutional capacity for monetary innovation - public banks and credit guidance mechanisms, successful digital infrastructure, environmental regulations - yet remains constrained by self-imposed orthodox frameworks. The BCB's narrow inflation-targeting mandate, legally entrenched through the 2021 autonomy law (Complementary Law 179/2021), legally prohibits the pursuit of environmental objectives that could utilize these capabilities. This represents what Gabor (2021) identifies as the "Wall Street Consensus" - the deliberate narrowing of state capacity to ensure monetary policy serves financial markets rather than democratic priorities.

A genuinely transformative approach would involve what Schroeder (2023) terms "developmental" central banking - direct CBDC lending from CBs to governments, financial institutions, and firms for specific green goals or SDGs. Although the analytical framework adopted in this paper is closer to the post-Keynesian and constitutional-political traditions, it is worth registering that proposals of this kind also resonate with the Modern Money Theory literature on sovereign money creation and the operational space of fiscal-monetary coordination (Wray, 2015; Fullwiler, 2017; Tcherneva, 2020). Recognising this convergence is important precisely to differentiate the argument: what is at stake here is not unlimited monetary financing,

but the political reconstitution of the criteria according to which monetary creation is allocated. Interest rates, collateral requirements, and terms would be differentiated according to ecological and social criteria rather than market signals. In Brazil's case, CBDCs could capitalize BNDES and public banks to fund projects meeting environmental policy conditions, leveraging existing institutional infrastructure for climate transition. The technical capabilities demonstrated by Pix and the Digital Real pilot, combined with Brazil's unique public banking system, create conditions for pioneering green monetary applications that could model alternatives for the Global South - but only if the political constraints of monetary orthodoxy are challenged.

The Brazilian case thus exemplifies a broader pattern in CBDC development globally: technical innovation proceeds while political change is ruled out. The Digital Real will likely succeed in digitalizing existing monetary relations while failing to transform them, reproducing rather than challenging the subordination of monetary policy to capital accumulation. Without confronting the political economy of CB independence and the hegemony of price stability, Brazil's CBDC risks becoming another example of the fetishization of technical solutions that Swyngedouw (2010) critiques - where complex political contradictions are reduced to techno-managerial problems.

Concluding remarks

This paper presented the role that CBs can and should play in addressing the climate crisis, integrating climate considerations not only into their regulatory, but also into their monetary policy framework, and explored the transformative potential of CBDCs as instruments for green monetary policy and constitute part of a broader climate policy initiative. Our analysis reveals a fundamental tension: while climate risks threaten financial and monetary stability mandates, CBs remain constrained by orthodox frameworks that depoliticize monetary governance and narrow their policy space to inflation targeting.

CBDCs represent a critical juncture where technological innovation meets ecological imperative. Drawing on Desan's (2014) understanding of money as a constitutional project, we argue that CBDC design choices embed political decisions about monetary power distribution that could either reinforce existing hierarchies or enable democratic alternatives. The programmability and traceability of CBDCs offer unprecedented opportunities to resurrect directed credit mechanisms that were historically effective for strategic economic transformation, as Monnet and van't Klooster (2023) document, while adapting them to contemporary climate challenges through smart contracts and real-time monitoring.

The Brazilian case proves particularly revealing. Despite possessing unique institutional advantages such as robust public banking, pioneering environmental credit regulations since 2008, and successful digital infrastructure demonstrated by Pix, the Digital Real's design reflects technological conservatism that preserves private banking privileges while excluding explicit

environmental objectives. This contradiction illuminates how self-imposed orthodox constraints prevent the mobilization of existing capabilities for climate action.

The pathways explored, from carbon-integrated CBDCs to programmable green stimulus, demonstrate technical feasibility but remain unrealized due to political economy barriers. Current CBDC designs globally reproduce rather than challenge the depoliticization of monetary policy, treating digital currencies as neutral infrastructure rather than opportunities to reconstitute CBs as democratic institutions capable of addressing the climate emergency. This necessitates what Dardot and Laval (2014) identify as the political principle of the common: the democratic institution of new forms of collective governance through co-activity and shared obligation, challenging both state and market logics that currently dominate monetary architecture. Without such fundamental transformation, CBDCs risk becoming digital reproductions of existing monetary relations rather than instruments of just transition.

Ultimately, realizing CBDCs' potential for climate transformation requires abandoning the fiction of monetary neutrality and recognizing monetary design as inherently political. This necessitates expanding CB mandates beyond price stability, developing new instruments that can address supply-side climate shocks, and creating institutional mechanisms for democratic participation in monetary governance. Only through such fundamental reimagining can CBs transcend their current limitations to become active agents of sustainable transformation rather than passive observers of climate risks.

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