How central banks support a balanced global transition

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To cite this article:
Moldoveanu (Cojocariu), A.E. (2026). How central banks support a balanced global transition. Romanian Journal of Economics, 63(2), 127-138.

Abstract. Objective*: This paper explores the part played by central banks in steering a balanced worldwide shift to a sustainable economy, looking at how climate and nature goals are being woven into the conduct of monetary policy and the safeguarding of financial stability, consistent with the Paris Agreement and the EU Green Deal. Particular attention is given to the way their responsibilities are changing as they deal with financial risks stemming from climate change and nature loss without compromising stable prices or a sound financial system.* ***Methodology****: A mixed research design is used: a theoretical reading of central bank mandates is paired with empirical material published by the European Central Bank (ECB), the U.S. Federal Reserve (Fed), the European Banking Authority (EBA) and the Network for Greening the Financial System (NGFS), together with the Bank for International Settlements (BIS), the International Monetary Fund (IMF) and the World Bank. Data and policy documents from 2021–2025, including key ECB and Fed updates in November–December 2025, are used to assess instruments such as portfolio alignment, green lending incentives, climate-adjusted collateral frameworks, and environmental scenario analysis.* ***Results****: The analysis shows that the ECB has progressively integrated climate and nature risks into its monetary policy, statistics, and stress-testing framework, as illustrated by the enhanced climate change indicators released in November 2025 and by the decision to build climate risk into the EU-wide stress test of 2025. By comparison, in October 2025 the Fed and the other U.S. banking regulators rescinded the guidance they had issued to large banks on managing climate-linked financial risks, which points to greater caution about bringing climate into regulation. Despite these divergences, there is growing global convergence around climate scenarios, disclosure standards, and the recognition of climate and nature as sources of systemic risk.* ***Originality****: The paper provides a timely and integrated perspective on how central banks are moving from a narrow risk-management approach to a broader agenda that treats sustainability as a strategic pillar of long-term financial stability and innovation, while also documenting recent policy asymmetries between major jurisdictions. It underscores that effective progress toward net-zero goals requires close coordination among monetary, fiscal, and supervisory authorities, as well as the private sector.*

Keywords: *central banks; monetary policy; climate change; economic sustainability; green transition; financial stability; innovation; ESG integration; energy transition; global governance*
JEL classification*: E52; E58; Q01; Q54; Q56; O33; G28*

1. Introduction

Global warming is rapidly approaching the critical threshold of 1.5°C, and recent assessments suggest that the remaining global carbon budget could be exhausted by around 2028 if current emission levels persist, making a temporary overshoot of this limit highly likely (IPCC, 2023). This threshold is

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not merely symbolic: exceeding it would imply accelerating sea-level rise, agricultural losses, infrastructure damage, climate-induced migration, and rising social tensions, with the difference between 1.5°C and 1.7°C potentially determining whether the world remains manageable or faces irreversible ecosystem breakdowns (Hot or Cool Institute, 2025).

In parallel with the climate crisis, the global economy is undergoing profound transformations driven by technological innovation and geopolitical tensions, which interact with environmental shocks and reshape macro-financial dynamics. Recent estimates indicate that extreme weather events generated more than USD 400 billion in economic losses in 2024 (Risk & Insurance, 2025), while 2024 was the hottest year on record since 1880 (IPCC, 2023). Under these conditions, sustainability and climate change have shifted from niche academic topics to strategic priorities for policymakers, financial regulators, the media, and the broader public (McKinsey Global Institute, 2024; OECD, 2022).

In this setting, the remit of central banks is widening: beyond their long-standing concern with stable prices and a sound financial system, they are increasingly expected to address the financial risks created by climate change and nature loss and to help the green transition proceed in an orderly way. Several leading international bodies, among them the BIS (2021), the IMF (Bossu & Rossi, 2019) and the NGFS (2022, 2023), have warned that climate change and biodiversity loss can become systemic risks, capable of destabilising the macroeconomy and of weakening the transmission of monetary policy. The same message comes from the ECB (2023, 2025), which argues that monetary policy and banking supervision should both take climate and nature factors into account. Nevertheless, central banks remain "climate policy takers": while they do not set environmental targets, they must account for the macro-financial implications of climate and nature crises within their mandates (Dikau & Volz, 2021; Volz, 2023). Recent policy debates, such as the discussion on green TLTROs (Jourdan & Simić, 2024), illustrate the evolving nature of the monetary policy toolkit.

Our purpose here is to assess the ways in which monetary authorities are able to foster a balanced worldwide move to a green and resilient economy without departing from their core objectives or overstepping their institutional limits. The analysis combines a conceptual assessment of central bank mandates (Dikau & Volz, 2021) with empirical evidence from recent policy developments, particularly in the euro area -- including climate indicators and climate-risk integration into supervisory stress tests (ECB, 2025a, 2025b; EBA, 2023, 2025), and in the United States, where supervisory approaches to climate risk have recently shifted (Federal Reserve Board et al., 2025). Additionally, the paper situates these developments within broader global coordination efforts such as the joint NGFS–Coalition of Finance Ministers initiative on climate scenarios and fiscal-monetary interaction (NGFS & Coalition of Finance Ministers, 2025).

2. Objectives and research methodology

2.1. Main objective

The main objective of the paper is to investigate how economic sustainability can be effectively achieved in the age of innovation by emphasizing the strategic role of central banks in supporting a balanced global transition toward a climate-neutral and resilient economic model. The analysis focuses on the dual challenge represented by climate change and the accelerating pace of technological transformation, highlighting the mechanisms through which monetary authorities contribute to environmental objectives and long-term financial stability (BIS, 2021; Dikau & Volz, 2021; Volz, 2023).

2.2. Specific objectives

The specific objectives are:

- To examine the complex interconnections between the natural environment, economic activity, and social structures within the broader framework of the climate and nature transition (IPCC, 2023; NGFS, 2023).
- To analyze the effects of the Paris Agreement on global energy and economic policies, with particular attention to the shift toward renewable energy and the progressive reduction of fossil fuel dependence (OECD, 2022; Hot or Cool Institute, 2025).

- To assess what central banks specifically add to financial stability by using tools that promote green lending and sustainable investment and that help to keep climate and nature risks under control, both nationally and internationally (BIS, 2021; ECB, 2023; EBA, 2023).
- To identify coherent public and monetary policy strategies that can foster innovation, mitigate transition risks, and ensure a fair and inclusive transformation of the global economy (McKinsey Global Institute, 2024; NGFS & Coalition of Finance Ministers, 2025).

2.3. Research methodology

Methodologically, the research blends three strands of economic analysis (theoretical, empirical and scenario-based) in order to trace how the contribution of central banks to the greening of the economy is changing.

Theoretical and conceptual analysis: This component builds on academic and institutional literature on central bank mandates, climate- and nature-related financial risks, and sustainable central banking, including key contributions by BIS (2021), IMF (Bossu & Rossi, 2019), NGFS (2022, 2023), and related research networks. The paper contributes to the existing literature by explicitly linking central banking tools (e.g., collateral frameworks, asset purchase programs, climate stress testing) with measurable transition outcomes, thereby addressing a gap between normative frameworks and operational implementation.

Empirical investigation: The empirical analysis draws on data, official reports, and policy communications from the ECB (2023, 2025), EBA (2023, 2025), IMF, World Bank, BIS, and NGFS, covering the period 2021–2025, including the latest policy updates from November–December 2025 (ECB, 2025a, 2025b; Federal Reserve Board et al., 2025). The analysis focuses on identifying patterns in central bank interventions, climate risk disclosures, and financial system adjustments. The documentary corpus was assembled through a purposive selection strategy, targeting primary institutional sources that have directly shaped the regulatory and supervisory landscape for climate-related financial risk over the reference period. The selection criteria required that each source meet at least one of the following conditions: (i) it constitutes an official policy document, supervisory guidance, or statistical publication issued by a central bank or international financial institution; (ii) it presents empirical data, stress-test results, or scenario projections that bear directly on how climate and nature risks are being built into monetary or prudential arrangements; or (iii) it represents a landmark regulatory development - such as the adoption or withdrawal of interagency principles - with material implications for central bank practice. On this basis, the core corpus comprises the following documents: ECB Climate and Nature Plan 2024–2025 (ECB, 2023); ECB Climate Change Indicators, November 2025 update (ECB, 2025a); the ECB Macroprudential Bulletin article explaining how climate risk enters the EU-wide stress test of 2025 (ECB, 2025b); EBA Roadmap on Sustainable Finance (EBA, 2023) and the EBA Guidelines on Environmental Scenario Analysis (EBA, 2025); BIS Green Swan report (BIS, 2021); NGFS Conceptual Framework for Nature-Related Financial Risks (NGFS, 2023) and the NGFS–Coalition of Finance Ministers joint initiative on climate scenarios (NGFS & Coalition of Finance Ministers, 2025); the joint decision of the Federal Reserve Board, the FDIC and the OCC to rescind their climate risk principles for large financial institutions (Federal Reserve Board et al., 2025); and IMF Working Paper on central bank governance (Bossu & Rossi, 2019). Secondary academic contributions (Dikau & Volz, 2021; Jourdan & Simić, 2024; Volz, 2023) were included where they provide analytical frameworks that complement the institutional evidence. Documents published outside the 2021–2025 window were retained only when they established foundational concepts - such as the green swan framework - that are indispensable for interpreting more recent developments. A complete list of all sources consulted is provided in the References section.

Hypothesis-driven framework: The study is guided by the following analytical working propositions, which serve as orienting frameworks for the qualitative and documentary analysis rather than as formally testable hypotheses in the econometric sense:

H1: When monetary policy frameworks take climate-related risks into account, financial stability is strengthened and the systemic risks associated with the transition are reduced.

H2: Central bank interventions (e.g., green asset purchases, differentiated collateral policies) contribute to lowering financing costs for sustainable investments.

H3: Enhanced ESG and climate-related disclosure requirements increase market efficiency by reducing information asymmetries. Each proposition is evaluated against the policy evidence gathered from the documentary corpus described above. Where the evidence is consistent with the proposition, this is noted explicitly; where it is mixed or absent, the limitations are acknowledged. This approach reflects the interpretive and documentary nature of the study, which draws structured inferences from institutional sources rather than producing original quantitative estimates.

Economic and scenario analysis: The economic dimension is extended through illustrative quantified scenarios assessing the impact of central bank measures on financial markets. For example, a preferential collateral treatment for green assets could reduce financing costs by an estimated 10–30 basis points (this figure is illustrative and order-of-magnitude in nature; it draws on the range reported in NGFS (2022) and BIS (2021) for the estimated pricing impact of central bank collateral policy adjustments, and should be interpreted accordingly rather than as a precise empirical finding) , influencing investment allocation and transaction volumes in sustainable assets. Similarly, climate-adjusted capital requirements may affect bank lending behavior, with potential shifts in portfolio composition toward lower-carbon sectors, thereby improving market efficiency and risk pricing.

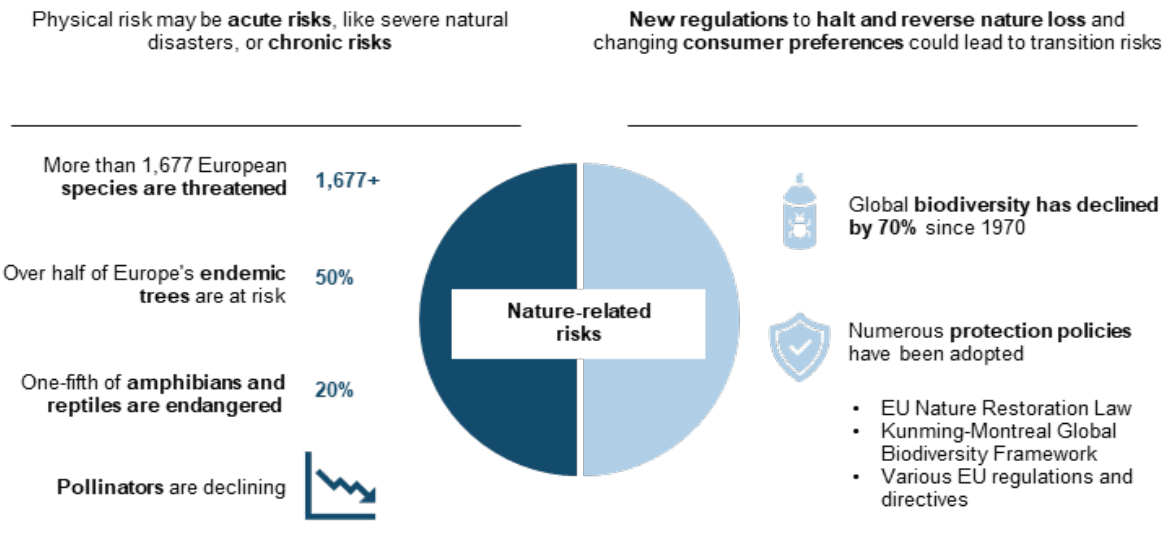
This integrated methodological framework enables a more robust and structured assessment of how energy and nature transitions reshape economic systems and how central banks can effectively support sustainable growth while remaining within their legal mandates.

3. From price stability to climate and nature risks

Historically, the core concerns of central banks have been stable prices and a sound financial system; today, however, climate change and the loss of nature are acknowledged as macro-critical forces capable of jeopardising both goals (NGFS, 2022; ECB, 2023). The term “green swans” was coined by the Bank for International Settlements to designate climate-driven events whose consequences may be severe, hard to predict and systemic (BIS, 2021).

In parallel, the NGFS and the ECB emphasise that nature degradation – including biodiversity loss, water stress and land-use change – can propagate through credit, market and operational risk channels (NGFS, 2023; ECB, 2023). Recent ECB work shows that a large share of euro area firms depends on ecosystem services and that a significant portion of bank lending is exposed to sectors vulnerable to physical risks such as water stress, heat stress and flooding (Ceglar et al., 2024; ECB, 2025a). Environmental shocks can therefore impair collateral values, weaken firms’ cash flows and increase default probabilities, thereby affecting the monetary policy transmission mechanism.

Figure 1. Nature degradation, including biodiversity loss, generates physical and transition risks for the European economy and the financial system



Source: Ceglar et al., 2024.

At the same time, the ESG framework has become central to ensuring long-term economic stability and resilience, particularly in vulnerable sectors and countries (OECD, 2022; Hot or Cool Institute, 2025). According to international reports, capital from both public and private sources must be mobilised urgently if the Paris Agreement targets are to be reached, and this has to happen alongside efforts to contain the social tensions and geopolitical risks that add to uncertainty. In this context, central banks and international financial institutions are emerging as strategic actors, supporting green economy policies and helping to channel capital towards sustainable investments.

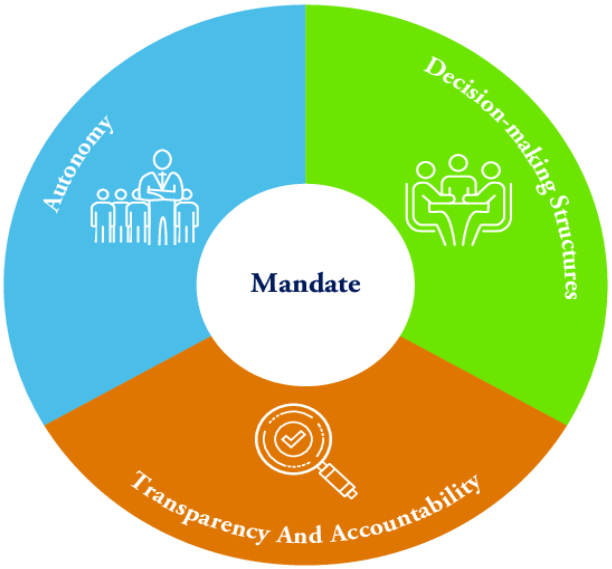
The figures highlight key patterns and relationships, clearly illustrating the impact of the analyzed variables on market dynamics and economic outcomes.

3.2 Mandates and legal constraints

Central banks must operate within the boundaries of their statutory mandates. For the ECB, keeping prices stable in the euro area comes first; provided that this primary goal is not compromised, the Bank is also required to back the Union's general economic policies, among which is the protection of the environment (ECB, 2023). How, and on what conditions, environmental and nature-related factors may be taken into account when monetary policy is implemented and banks are supervised is set out in the ECB's Climate and Nature Plan 2024–2025 (ECB, 2024).

Figure 2 illustrates the concept of central bank governance, highlighting its core components and institutional relationships as presented by IMF staff.

Figure 2. Central bank governance – the concept



Source: Bossu & Rossi, 2019.

By contrast, the Federal Reserve has a narrower mandate focused on maximum employment and price stability, which helps explain its more cautious approach to climate-related supervision. In October 2025, US regulators rescinded the principles they had drawn up to guide large financial institutions in managing climate-linked financial risks, on the grounds that the risk management rules and supervisory expectations already in place adequately cover every material risk, climate change included (Federal Reserve Board et al., 2025).

4. Key instruments for supporting a balanced transition

A variety of monetary and prudential tools are now being used by central banks in support of the green transition, although these tools are not meant to replace fiscal or environmental policy.

4.1 Portfolio alignment and asset purchases

Portfolio alignment means that climate criteria are taken into account when a central bank buys assets. In the ECB's case, corporate bond purchases have been tilted in favour of issuers that emit fewer greenhouse gases and have credible transition plans, so that the holdings become more consistent with EU climate objectives; the Bank also publishes climate metrics for both its monetary policy portfolios and its non-monetary policy portfolios (ECB, 2025e). The intention is to make the central bank's balance sheet less carbon-heavy and to limit its exposure to the transition risks posed by high-emission issuers.

Other central banks follow NGFS guidance on portfolio management and disclosure (NGFS, 2022). However, portfolio alignment faces challenges such as limited data quality and coverage, the risk of unintended market distortions, and the need to preserve market neutrality and the effectiveness of monetary policy transmission.

4.2 Green lending incentives and refinancing operations

Green lending incentives include targeted refinancing operations that provide more favourable funding conditions for banks that finance low-carbon sectors, energy-efficiency projects or climate-adaptation investments. While the ECB has not introduced a fully-fledged "green TLTRO" so far, it has signalled openness to considering environmental criteria in future targeted operations, provided that such measures remain proportionate and consistent with its primary mandate (Jourdan and Simić, 2024). Green credit lines and preferential refinancing schemes have already been tested by a number of national central banks and development banks as a way of financing renewable energy and energy-saving projects.

Such tools can make the transition less risky: they reduce the cost of funding for sustainable projects and send a signal that the central bank stands behind green investment, particularly if they are accompanied by robust taxonomies and disclosure frameworks.

4.3 Climate-adjusted collateral frameworks and credit ratings

Collateral frameworks are a powerful lever because they determine which assets banks can use to obtain central bank liquidity and at what haircuts. Central banks can adjust eligibility criteria or haircuts to reflect climate and nature-related risks, for example by applying higher haircuts to securities issued by firms with elevated transition risks or by treating high-quality green assets more favourably.

In cooperation with external credit rating agencies, the ECB has sought to make sure that credit assessments properly capture climate risks, and it has defined minimum requirements for the way climate factors enter the ratings accepted in its collateral framework (ECB, 2025d). This approach aims to reduce cliff-edge effects and promote more consistent pricing of climate risks across financial markets.

4.4 Disclosure, transparency and scenario analysis

Disclosure and transparency are fundamental for market discipline and risk pricing. The EBA's Roadmap on Sustainable Finance (2023–2025) and its guidelines on ESG risk management require EU banks to identify, measure and disclose their exposures to climate and environmental risks, including through the ICAAP and Pillar 3 reports (EBA, 2023; EBA, 2025). European regulations such as the CSRD, complemented by EBA and EIOPA guidance, progressively embed ESG principles into financial governance and reporting, supporting a more coordinated transition across the EU.

The toolkit is rounded off by scenario analysis and stress tests. Building on its detailed climate scenarios, the NGFS issued in 2025 a revised version of its guide on climate scenario analysis, which gives central banks and supervisors practical advice on how climate stress tests can be designed and run (NGFS, 2025). For its part, the ECB is building climate risk into the EU-wide stress test of 2025 in order to gauge how resilient banks are under transition and physical-risk scenarios, while the EBA has finalised guidelines on environmental scenario analysis that set out what is expected of banks' risk-management frameworks (ECB, 2025b; EBA, 2025).

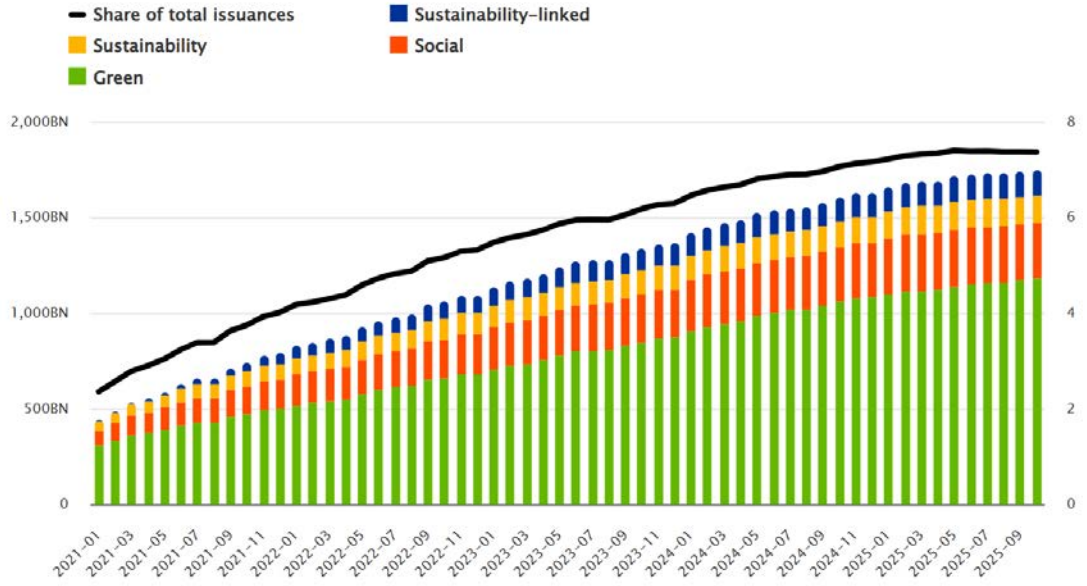
5. Recent ECB and Fed policy developments (November–December 2025)

5.1 ECB: climate change indicators and stress test integration

On 27 November 2025, the ECB released an updated set of climate change indicators, providing new statistics on sustainable finance, financed emissions from banks' loan and securities portfolios, and exposures to physical risks across the euro area (ECB, 2025a). The data show that financed emissions decreased significantly between 2018 and 2023 even as underlying portfolios expanded, indicating progress in decarbonisation, while exposures to physical risks such as heat, drought and flooding increased and exhibit significant cross-country differences.

Figure 3 presents key sustainable finance indicators, highlighting trends and developments based on data from the Centralised Securities Database (CSDB).

Figure 3. Sustainable finance indicators



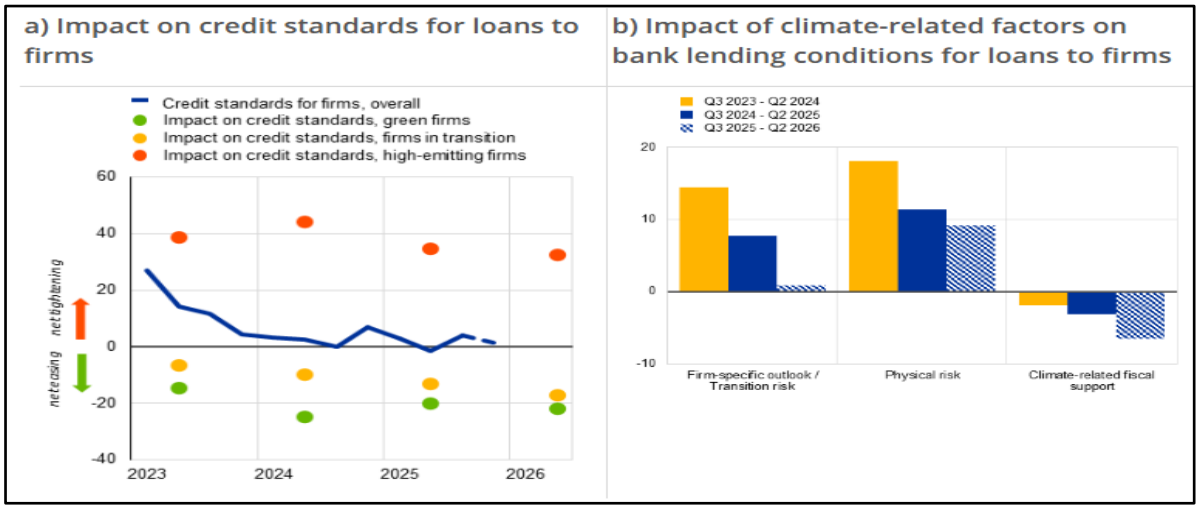
Source: ECB (2025a), based on the Centralised Securities Database (CSDB).

In November 2025, the ECB also explained how climate risks will be incorporated into the 2025 EU-wide stress test, extending previous exercises to cover both transition and acute physical-risk scenarios for banks' credit portfolios (ECB, 2025b). This marks a step-change in mainstreaming climate risk into macro-prudential supervision, with climate scenarios informing capital-adequacy assessments and supervisory expectations.

Figure 4 illustrates the impact of climate change on credit standards for loans to euro area firms, highlighting the main underlying drivers based on ECB Bank Lending Survey (BLS) data.

ECB blog posts from November 2025 add that euro area banks increasingly factor firms' climate performance into their lending terms, and that the ECB itself is fine-tuning the treatment of climate risks in credit ratings and collateral rules (ECB, 2025c, 2025d). These developments confirm the ECB's strategy of embedding climate and nature considerations into its core monetary policy and supervisory tools.

Figure 4. Impact of climate change on credit standards for loans to euro area firms and main drivers



Source: ECB (2025c), based on the euro area bank lending survey (BLS).

5.2 Fed: withdrawal of climate risk principles

In the United States, the picture is different. On 16 October 2025 the three federal banking agencies (the Federal Reserve, the Federal Deposit Insurance Corporation, FDIC, and the Office of the Comptroller of the Currency, OCC) announced that they were rescinding their interagency principles on how large financial institutions should manage climate-related financial risks (Federal Reserve Board et al., 2025). The agencies stated that existing risk-management frameworks and supervisory expectations are sufficient to address all material risks, including those stemming from climate change, and that separate climate-specific principles are therefore not necessary.

This decision effectively halts the development of dedicated climate risk-management guidance for large US banks and reflects a more cautious regulatory stance on explicitly integrating climate considerations into prudential supervision. Commentators argue that this divergence from the EU and NGFS recommendations may increase the risk of regulatory fragmentation and could hinder international coordination on climate-related financial risks.

6. Challenges, trade-offs and international coordination

Central banks face multiple challenges when mainstreaming sustainability into their operations and policies. These include mandate limitations and political-economy constraints, data gaps and methodological uncertainty – particularly for nature-related risks – fragmented taxonomies and regulatory divergence, together with the distributional and social consequences that greening the economy entails.

At the same time, international coordination is strengthening. The NGFS now brings together more than 130 central banks and supervisors and, in cooperation with the Coalition of Finance Ministers for Climate Action, promotes the use of shared climate scenarios to inform both monetary and fiscal policies (NGFS, 2023). These efforts seek to harmonise methodologies, improve data sharing and support coherent policy responses to climate and nature-related financial risks.

7. Future outlook: from risk management to opportunity creation

To enhance the robustness and transparency of the forward-looking analysis, this section is complemented by structured and easily verifiable formats. Specifically, the study includes (i) a comparative table between the ECB and U.S. authorities (Federal Reserve, FDIC, OCC), covering mandates, instruments, key measures implemented during 2021–2025, and recent policy shifts in 2025,

and (ii) a policy–risk mapping matrix that links central bank tools to their transmission channels, targeted risk types (transition, physical, nature-related), and associated indicators.

Table 1. Comparative framework (ECB vs. U.S. authorities)

ECB and U.S. authorities – mandates, instruments and climate-related measures (2021–2025)

Dimension	European Central Bank (ECB)	U.S. authorities (Federal Reserve, FDIC, OCC)
Core mandate	Primary objective: stable prices in the euro area. Secondary objective: backing the Union's general economic policies, provided price stability is not put at risk. Also contributes to financial stability.	Federal Reserve: dual mandate of maximum employment and stable prices. FDIC and OCC: mandates centred on the safety and soundness of banks and on financial stability.
Climate and sustainability integration	Climate and environmental risks have been brought step by step into monetary policy operations, the collateral framework, asset purchases and supervisory expectations (e.g. climate stress testing and climate-related disclosures).	At first, climate-related financial risk was acknowledged as a growing danger for financial stability and high-level principles were issued for large institutions; in 2025 this course was partly reversed and some climate risk principles were withdrawn.
Key instruments used for climate and nature risks	Adaptation of collateral frameworks and corporate bond portfolios to reflect climate considerations; climate stress tests at system and firm level; incorporation of transition policies into macroeconomic projections.	Supervisory guidance and principles telling large banks how to manage climate-linked financial risks; climate risk treated as part of risk management expectations, not as part of core monetary policy tools; interagency principles later rescinded in 2025.
2021–2024 key measures	Publication and implementation of an economy-wide climate stress test (2021) and follow-up exercises; gradual decarbonisation of monetary policy portfolios; development of climate and nature-risk integration into monetary policy and supervision.	Climate change named as a growing danger for financial stability; interagency principles on managing climate risk issued to large financial institutions; supervisory dialogue on climate risk practices.
2025 policy developments	Climate and nature risks further built into the 2025 EU-wide stress test, as well as into collateral and risk management frameworks; roadmap towards a "climate factor" in collateral haircuts and enhanced climate-related disclosures.	Interagency principles on managing climate-linked financial risks rescinded, which signals a move back to the existing general safety and soundness standards, with no dedicated climate principles.

The next phase of central bank action should move beyond a narrow focus on risk mitigation towards enabling innovation, resilience and opportunity creation. This includes embedding climate and nature indicators into core macroeconomic and risk-assessment models, expanding green collateral frameworks and transition-finance tools, supporting international convergence on taxonomies, stress-testing methodologies and disclosure standards, and fostering public–private partnerships to scale up investment in low-carbon technologies, nature-based solutions and just-transition projects.

Table 2. Policy–risk mapping matrix (simplified)

Instrument	Transmission channel	Risk type	Key indicator
Collateral framework	Bank funding and collateral valuation	Transition	Carbon intensity of eligible assets
Asset purchases / tilting	Asset prices and financing conditions	Transition, physical	Share of green assets in portfolios
Climate stress tests	Risk management and capital planning	Transition, physical, nature	Losses under climate scenarios

This simplified matrix links central bank instruments to their main transmission channels, risk types and indicative metrics.

Ultimately, the objective is to turn sustainability from a checklist-based agenda into a strategic pillar of central banking, so that resilience to climate and nature shocks becomes part of the mandates for stable prices and a sound financial system (McKinsey Global Institute, 2024).

8. Conclusions

Central banks are key players in moving the financial system onto a sustainable path. They do not take the place of governments; they back them with consistent monetary and supervisory action (see ECB, 2021; Board of Governors of the Federal Reserve System, 2022, 2023, 2024). The ECB's recent record illustrates this. It launched, and later refined, statistical indicators on sustainable finance, carbon emissions and physical risk (ECB, "Climate change-related indicators", first published January 2023, updated 2024–2025); it brought climate risk into its supervisory and system-wide stress tests (ECB, 2022, 2025b); and it decided to add a climate factor to its collateral framework, drawing on the data produced by the 2024 climate stress test (ECB, 2025d). Taken together, these steps show that climate and nature considerations can be embedded directly into central bank operations. The opposite course was taken in the United States, where in October 2025 the federal bank regulators, the Federal Reserve among them, rescinded their interagency climate risk principles for large financial institutions; this shows that approaches differ widely across countries and reflect not only technical choices but also legal and political constraints (Federal Reserve Board et al., 2025; OCC, 2025; see also secondary analyses, e.g. Costa, 2025).

Achieving a balanced global transition requires much more than isolated policy adjustments. It implies bringing climate- and nature-related risks into the core of monetary policy frameworks, strengthening micro- and macroprudential supervision, encouraging green financial innovation, and ensuring that public and private actors work together (in line with the recommendations of the NGFS (2022, 2023, 2025), the BIS (2021) and the recent literature on "greening" monetary policy; Dikau & Volz, 2021; Jourdan & Simić, 2024; Volz, 2023). Coordination, trust and transparency are essential if central banks are to contribute meaningfully to climate neutrality and long-term economic resilience while still respecting their mandates and institutional independence, a point emphasized both in the ECB's policy documents and in debates on the Federal Reserve's mandate on climate risks.

Of course, this paper also has its limitations. The findings depend on the data currently available, which remain incomplete and sometimes inconsistent, especially for nature-related and biodiversity-related risks, an aspect explicitly signaled by producers of official statistics when they describe climate indicators as initially "experimental and analytical" and subject to methodological improvements (ECB, 2023; Nefzi & Gosset, 2023). The analysis focuses mainly on the ECB and the Fed, which means that the specific difficulties confronting central banks in emerging and developing economies may be only partly reflected in the conclusions, where exposure to physical climate risks is often higher and institutional capacities differ. Moreover, because climate policy and financial regulation evolve extremely fast, new developments - such as the 2024–2025 updates to climate indicators or changes in supervisory expectations - quickly go beyond the 2021–2025 timeframe considered here. Finally, while the paper examines mandates and available tools, it does not explore in depth the political pressures and institutional constraints that shape central bank choices, even though recent controversies around the rollback of US climate-risk guidance underscore their importance.

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